PB91-125724

Impact of Lead and Other Metallic Solders on Water Quality

Holzmacher, McLendon and Murrell, Melville, NY

Prepared for:

Environmental Protection Agency, Cincinnati, OH

Feb 90

U.S. Department of Commerce
National Technical Information Service
NTIS

PB91-125724

EPA/600/2-90/056

IMPACT OF LEAD AND OTHER METALLIC SOLDERS ON WATER QUALITY

by

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Cooperative Agreement CR-8100958-01-1

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This study was conducted in cooperation
with the South Huntington Water District
Huntington Station, New York 11746

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TECHNICAL REPORT DATA
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1. REPORT NO. EPA/600/2-90/056	2.
3. PB91-125724	
4. TITLE AND SUBTITLE IMPACT OF LEAD AND OTHER METALLIC SOLDERS ON WATER QUALITY	5. REPORT DATE 2-90
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) NORMAN E. MURRELL	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS H2M/Holzmacher, McLendon, Murrell, P.C. Melville, New York 11857-5076	10. PROGRAM ELEMENT NO.
	11. CONTRACT/GRANT NO. CR-8100958
12. SPONSORING AGENCY NAME AND ADDRESS Risk Reduction Engineering Laboratory Office of Research and Development U.S. Environmental Protection Agency Cincinnati, OH 45268	13. TYPE OF REPORT AND PERIOD COVERED
	14. SPONSORING AGENCY CODE EPA/600/14

15. SUPPLEMENTARY NOTES
Project Officer: Marvin C. Gardels (513) 569-7217; FTS 684-7217

16. ABSTRACT
A study of the relationship between water quality at the consumer's taps and the corrosion of lead solder was conducted under actual field conditions in 90 homes supplied by public water in the South Huntington Water District (New York) and at 14 houses supplied by private wells in Suffolk County on Long Island (New York). The South Huntington Water District water supply is composed of wells that feed water to a series of storage tanks from which water is distributed to individual homes. The 90 homes were selected to provided 10 sites of 9 house construction age groups--from new to those more than 20 years old. The study was done in three phases three different pH ranges (5.0-6.8, 7.0-7.4, and 8.0 and greater). The phase I study was preformed without any pH adjustments on the water sources. Phase II and III studies consisted of raising the pH by the addition of caustic soda and maintaining pH for thirty days prior to the sampling. After an overnight period of nonuse, a series of samples were collected at specific time intervals to evaluate the effect of time on the leaching rate of lead. Data were collected on leaching of cadmium and copper and water quality parameters were monitored. In the 2nd part of the investigation, a more controlled, four-pipe loop study was conducted with the same corrosive Long Island water. Each pipe loop consisted of approximately 60 feet of copper pipe with 22 solder joints, each loop having a different type of solder: 1) tin/lead; 2) tin/antimony; 3) silver/copper, and 4) tin/copper. The four loop solder test results indicate the tin/antimony, silver/copper, and tin/copper can be used with only minor metal leaching

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

18. DISTRIBUTION STATEMENT Release to Public	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 99
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

DISCLAIMER

The information in this document has been funded wholly or in part by the United States Environmental Protection Agency under Assistance Agreement Number CR810958-01-1 to the South Huntington Water District. It has been subject to the Agency's peer and administrative review and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

FOREWORD

The United States Environmental Protection Agency is charged by Congress with protecting the Nation's land, air and water systems. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activites and the ability of natural systems to support and nurture life. The Clean Water Act, the Safe Drinking Water Act and the Toxic Substances Control Act are three of the major congressional laws that provide the framework for restoring and maintaining the integrity of our Nation's water, for preserving and enhancing the water we drink, and for protecting the environment from toxic substances. These laws direct the EPA to perform research to define our environmental problems, measure the impact, and search for solutions.

The Water Engineering Research Laboratory is that component of EPA's Research and Development program concerned with preventing, treating and managing municipal and industrial wastewater discharges; establishing practices to control and remove contaminants from drinking water and to prevent its deterioration during storage and distribution; and assessing the nature and controllability of releases of toxic substances to the air, water and land from manufacturing processes and subsequent product uses. This publication is one of the products of that research and provides a vital communication link between the researcher and the user community.

The study reported herein focuses upon a major problem in drinking water at the faucet of the consumer. As a result of lead solder utilized to connect piping in residential and non-residential interior plumbing, levels of lead and other contaminants greater than desirable are introduced into potable water due to leaching. These effects can be reduced by the ban on lead solder in potable water supply piping. Metal leaching can be mitigated by the water utility reducing the corrosivity of the drinking water supplied to the consumer. Reducing this contamination by lead in the drinking water will help the health and welfare of the consuming public.

E. Timothy Oppelt, Director
Risk Reduction Engineering Laboratory

ABSTRACT

A study of the impact of lead and other metallic solders on water quality was conducted under actual field conditions at test sites in the South Huntington Water District and at private well test sites in Suffolk County on Long Island. Test sites were selected to provide approximately ten sites in each of nine age groups from new construction to more than 20 years old.

Long Island's groundwater supply is generally low pH, low alkalinity, low hardness water which is extremely corrosive without treatment. Tests were conducted after an overnight period of non-use at first draw and seven time periods after first draw. Lead was tested in all eight time-series samples, with cadmium and copper tested in the first draw water. Water quality parameters checked for were pH, alkalinity, Langelier Saturation Index, hardness, chlorides and total dissolved solids.

The South Huntington Water District adjusted its pH treatment for at least a month prior to initiating any phase of the study in an attempt to minimize transition effects on the house service and interior plumbing. Sites were tested after maintaining treatment at three pH ranges (6.4 and less, 7.0 to 7.4, 8.0 and greater).

In the second phase of the investigation, a more controlled four-loop study was conducted with the same corrosive Long Island water. Each loop consisted of 22 solder joints so tin/lead solders could be compared with three substitute solders for metal leaching. The three alternate solders were tin/antimony, tin/silver, and tin/copper.

Results of the overall investigation indicated the need for a "Lead Solder Ban" and also a need for water utilities to reduce the corrosivity of their water. In 258 tests at 104 sites, 90 test results (or 34.9 percent) of first draw samples exceeded the current 50 μg/L drinking water standard for lead. If the Recommended Maximum Contaminant Level becomes 20 μg/L for lead, 135 test results (or 52.3 percent) of first draw samples would exceed that standard.

There is an apparent relationship between the age of the lead solder and its ability to leach lead into the premises' drinking water. If the recently enacted "Lead Solder Ban" is effectively enforced by municipal plumbing departments, four or five years later, there would be little need to be overly concerned with the leaching of lead from existing lead solder.

Water utilities with corrosive water should increase the pH and alkalinity in their water. Testing for both lead and copper leaching in the same homes at three different levels of corrosivity indicates a significant reduction in the lead and copper leaching with less corrosive water.

The four loop solder test results indicate that tin/antimony solder, tin/silver solder and tin/copper solder can be used at proper pH and alkalinity with only minor metal leaching.

This report was submitted in fulfillment of Cooperative Agreement CR 810958-01-1 in cooperation with the South Huntington Water District. Work on this project was done under a subcontract by Holzmacher, McLendon and Murrell with the South Huntington Water District. This report covers the period from October 1983 to October 1987, and work was completed as of March 1988.

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LIST OF ABBREVIATIONS AND SYMBOLS

Abbreviations

AA	--	atomic absorption spectrophotometry
EPA	--	United States Environmental Protection Agency
gal	--	gallons
H2M	--	H2M Group/Holzmacher, McLendon & Murrell, P.C.
L	--	liters
LSI	--	Langelier Saturation Index
MCL	--	maximum contaminant level
mg/L	--	milligrams per liter
NCHD	--	Nassau County Health Department
SCDHS	--	Suffolk County Department of Health Services
sec	--	second
SHWD	--	South Huntington Water District
µg/L	--	micrograms per liter
ug/dL	--	micrograms per deciliter
U.S.EPA	--	United States Environmental Protection Agency
yr	--	year

Symbols

Ca	--	calcium
$CaCO_3$	--	calcium carbonate
Cd	--	cadmium
CO_3	--	carbonate
Cu	--	copper
Pb	--	lead
pH	--	$-\log (H^+)$

ACKNOWLEDGMENTS

This study could not have been accomplished without the assistance of personnel at both the South Huntington Water District and H2M Group/ Holzmacher, McLendon & Murrell, P.C. and concerned personnel in the United States Environmental Protection Agency in Cincinnati, Ohio, and Washington, D.C. The author expresses his gratitude to Dr. Marvin C. Gardels of the U.S. Environmental Protection Agency for acting as Project Director and Commissioner George Kopp of the South Huntington Water District for acting as Project Manager.

I gratefully acknowledge the help of Superintendent Vincent Crimaudo of the South Huntington Water District in obtaining test sites, scheduling the sampling and adjusting the water treatment for the various phases of the project, and Robert Smith of the Water District on the three sampling phases.

I wish to express may appreciation to the Suffolk County Department of Health Services for its cooperation in the private well aspects of the program.

The cooperation of H2M Group personnel Fran Marrotta and Karen Marrotta in the three sampling phases, including computer input/output, plus the computer-generated graphics by Stephen P. Olafsen and Linda J. Farmer and overall supervision of Eugene R. Olafsen are gratefully appreciated. My thanks also goes to H2M Labs personnel for the myriad of tests and to Stuart W. Murrell for coordinating and expediting the testing and results. I am particulary appreciative of Marie A. DeBonis, who spent many a night and weekend on the word processor generating the report and last, but not least, to John J. Molloy, P.E., for his indispensable help and assistance during the project and constructive comments in reviewing the report.

SECTION 1

INTRODUCTION

GENERAL PROBLEM

Lead, far in excess of the current 50 μg/L Maximum Contaminant Level (MCL) in the Federal Drinking Water Standards, has been found leaching from lead solder through testing from Maine to California. Lead solder is utilized to connect copper piping in residential and commercial plumbing systems for a potable water supply. Young children, in their formative years, are especially susceptible to lead poisoning (1).

CORROSION

Lead leaching is one part of the total corrosion problem. Corrosion is a phenomenon commonly associated with a metal and its environment, and is of considerable importance in water supply (2). In 1979, the National Bureau of Standards (NBS) reported that annual cost of damage caused by corrosion in the water supply field totaled about $700 million (3). However, these costs cover only effects on distribution systems. Often, a far greater portion of corrosion cost is incurred through damage to plumbing systems in homes.

Corrosive water can cause either health or aesthetic problems for the consumer, plus economic problems in distribution pipelines and in home plumbing systems. Corrosion of materials in plumbing and distribution systems can increase the concentrations of metal compounds in the water because lead, cadmium and other heavy metals are present in various amounts in pipe solder and other piping appurtenances such as faucets and fittings. There is concern for the possible health hazards created by corrosion and subsequent leaching and ingestion of these materials.

Several studies have documented the impact of metallic solder on water quality. This report presents the results of an intensive study of this problem conducted by H2M (Holzmacher, McLendon & Murrell), the South Huntington Water District, Long Island, New York, and the Suffolk County Health Department. The study was precipitated by a case of lead poisoning of a child in Smithtown, New York.

OCTOBER 1982 LEAD POISONING CASE

Complainant Home

H2M/Holzmacher, McLendon & Murrell, P.C.'s involvement with metallic solders, and particularly lead solder, began in October 1982 when a western Suffolk County (New York) Water District called H2M Lab about a consumer complaint of lead poisoning. Water as a source of lead was at first discounted, since the Water District had a 15-year record of lead-free distritution samples. It is now realized that this was due to following standard

sampling procedures of running the water three to five minutes prior to sampling. This normally provides a distribution system sample instead of the house service water consumed by many children and adults.

Two separate samples taken by the consumer in his own home showed lead levels of 1900 and 1600 μg/L (parts per billion), which were far greater than the current safe drinking water standard of 50 μg/L. H2M Lab personnel followed standard procedures of running the water three to five minutes prior to sampling. This resulted in 27 μg/L lead in that sample. At that point, it confirmed studies by others that lead concentration was a function of "time". Tests at three locations in the home at first draw and after one minute of flow resulted in lead as indicated in Table 1.

TABLE 1. INITIAL TIME INTERVAL LEAD SAMPLING

Location	First Draw Lead (μg/L)	One Minute Lead (μg/L)
Bathroom - Cold	900	64
Upstairs Bathroom - Cold	3900	14
Upstairs Bathroom - Hot	500	90

In the complainant's home, a time series test for lead was run after approximately a four-hour period of non-use. The first draw value of lead was 300 μg/L, and it took about 48 seconds for the lead value to reduce to below the current MCL as indicated in Figure 1.

Since the distribution system water and water at the inlet side of the meter in the basement actually tested for minimal lead, lead solder in the home's copper plumbing was suspected as the source of the lead. A visual inspection in the basement indicated lead caked on a newly installed water filter.

Subdivision and Nearby Testing

All 18 homes in the generally eight-year old subdivision were then tested for lead in their drinking water. Two existing occupied homes with first draw lead values above the current 50 μg/L MCL both had recent plumbing additions. A new home under construction had an even higher first draw lead value of 7100 μg/L.

Other older homes and hydrants within the Water District were tested for lead, and the results indicated that the water in the distribution system was essentially lead-free.

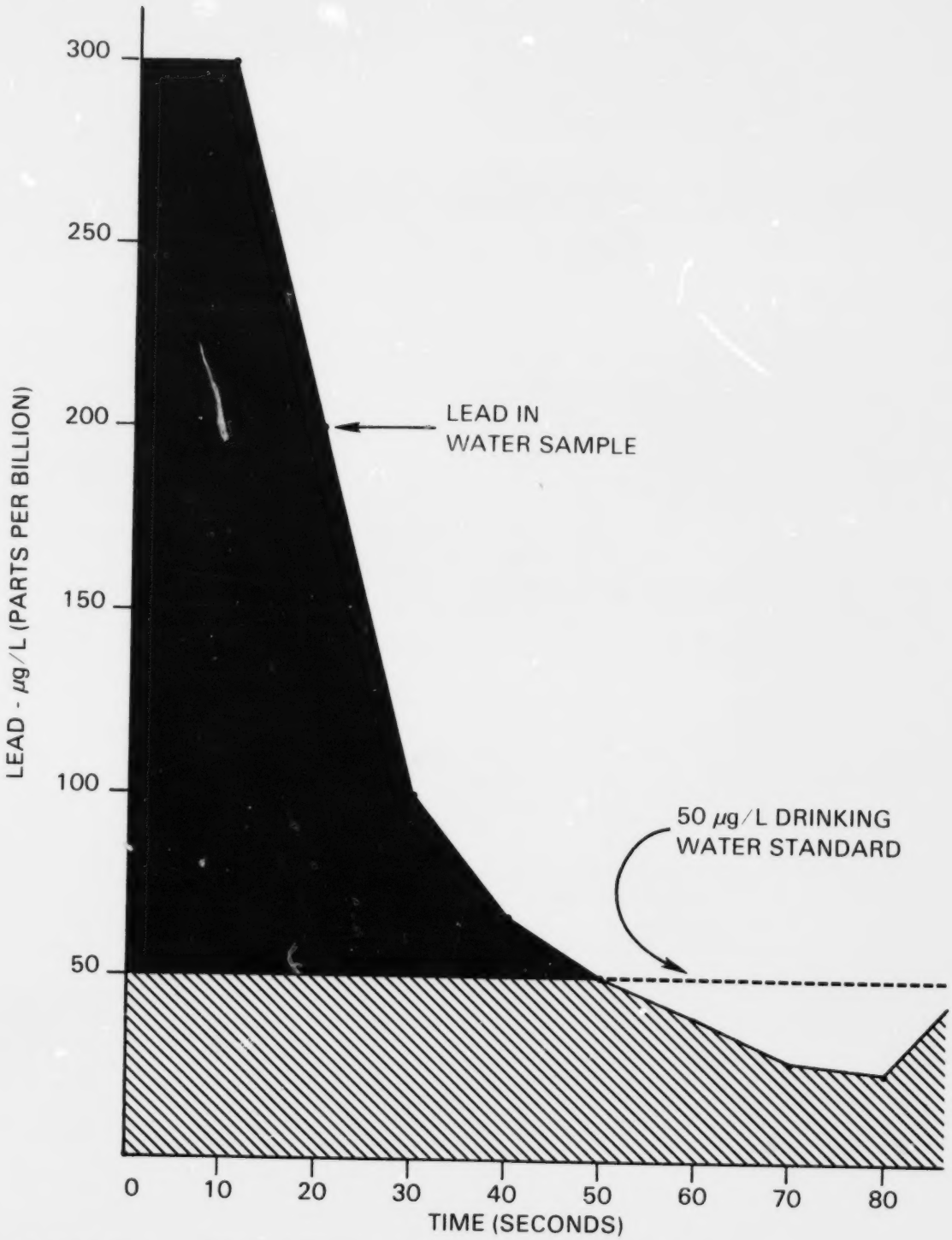

FIGURE 1. TIME SERIES LEAD SAMPLE IN UPSTAIRS BEDROOM BATHROOM SMITHTOWN RESIDENCE

House Under Construction

A new home under construction in the original complainant's subdivision was again checked after obtaining the 7100 μg/L first draw value for lead. In a time series test for lead, the first draw value was 2500 μg/L and it took about 80 seconds to approach the current MCL, as indicated in Figure 2.

Town of Smithtown Lead Solder Ban

Within six weeks of the initial lead complaint, a preliminary investigation was conducted by H2M and a November 30, 1982, and a Report was sumitted to the Town Board of the Town of Smithtown (4). The Town Board advertised and scheduled a public hearing to propose to limit the lead content in solder for drinking water services to 0.2 percent. On December 26, 1982, the lead solder ban was approved and made effective immediately in the town of Smithtown.

LONG ISLAND TESTING BY H2M

Long Island's source of potable water is its sole source aquifer, which is characterized by its low pH and soft water. In order to confirm that the lead leaching problem might be associated with water chemistry rather than one water utility, first draw tests were conducted by H2M Lab at a number of locations served by seven other Long Island water utilities. First draw values for lead ranged from 2,000 μg/L in new residences to <2 μg/L in 20 year old residences.

A controlled test was run on a 23-month old copper plumbing system in H2M's office building after a 71-1/2 hour shutdown, which is equivalent to many long weekends. The first draw lead result was 120 μg/L, with a second high of 200 μg/L at 1-1/2 minutes. The plumbing was measured in the ceiling, and solder joints were located until the service met the main source of water. After calculating the amount of water in the system between soldered joints versus the measured rate of low, it was calculated that the highest level (200 μg/L at 1.5 minutes) for lead coincided with the location where there was the greatest number of solder joints. The lead results from the office building are indicated in Figure 3.

The water from an older portion of the plumbing system that was four years old was calculated as the water tested after the two-minute point on Figure 3.

LONG ISLAND CONFIRMING TESTS BY OTHERS

In late November and early December, 1982, H2M alerted the Nassau and Suffolk County Health Departments, 13 Long Island towns with a total population of 2.5 million and the water suppliers of the findings on the leaching of lead from lead solder. It was natural for most to doubt the findings,since they also had not found high lead values in distribution

FIGURE 2. TIME SERIES LEAD SAMPLE IN UPSTAIRS BEDROOM BATHROOM RESIDENCE UNDER CONSTRUCTION

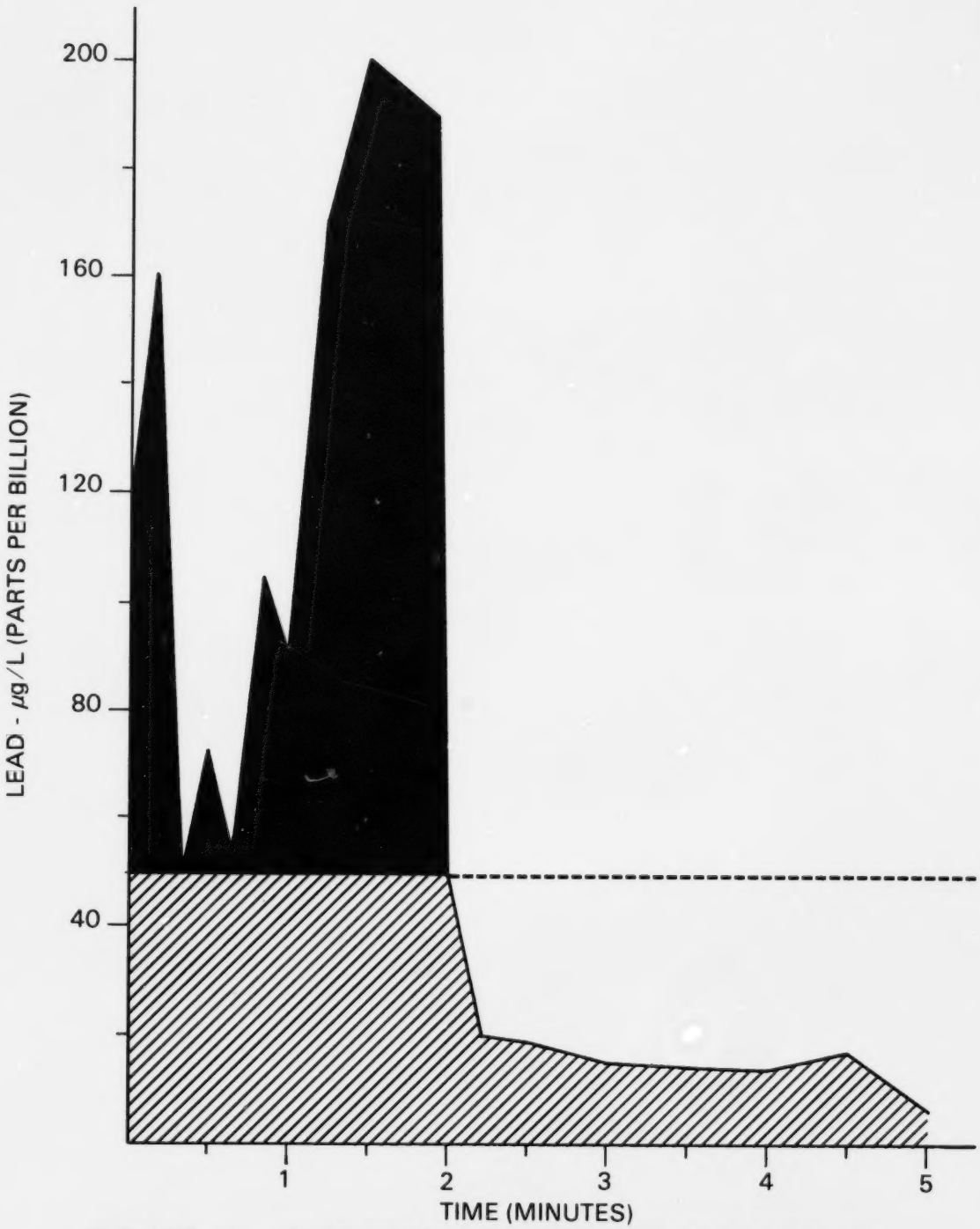

FIGURE 3. TIME SERIES LEAD SAMPLE IN KITCHEN SINK-MELVILLE OFFICE BUILDING (23 MONTH AND 4 YEAR OLD PLUMBING)

systems under normal sampling procedures of three to five minutes of flushing prior to sampling.

Suffolk County Water Authority

The Suffolk County Water Authority, which supplied water wholesale to the western Suffolk Water District serving the initial complainant's home, first did split sampling with H2M Lab to confirm that the lab testing was correct. They also conducted independent testing on water collected from a one-year old garage of the Kings Park School District. The first draw was 280 μg/L lead, with the one-minute test being 25 μg/L lead.

Suffolk County

The Suffolk County (New York) Department of Health Services found 200 to 600 μg/L in the water in the new Shirley Health Center.

On December 28, 1982, the Suffolk County Legislature adopted a resolution encouraging all ten towns to consider amending their building codes to ban lead solder.

The Suffolk County Department of Health Services released a fact sheet entitled "Lead in Drinking Water Supplies" on January 3, 1983, and recommended the modification of existing building codes to limit the lead content in solder used for water systems to 0.2 percent or less. In addition, the Department of Health Services held a seminar on "Lead Corrosion" on May 3, 1983.

Nassau County Department of Health

The Nassau County Department of Health initiated lead sampling in late December 1982. A total of 240 separate samples were collected from 59 different sampling locations in 35 premises served by 14 different public water systems. The significance of the lead leaching problem in newer homes is exemplified by some of the higher values for lead leaching as contained in Table 2.

TABLE 2. NASSAU COUNTY FIRST DRAW LEAD VALUES

Location	Lead µg/L	pH	Hardness mg/L	Percent Lead in Solder	Age (yrs)
Locust Valley	17000	7.0	41	60.3	0
Port Washington	4400	6.8	49	61.7	1
Manorhaven	3500	6.8	49	47.9	0
Woodbury	2900	7.3	64	58.4	0
N. Port Washington	930	7.0	49	50.3	0
North Hills	750	6.7	23	56.2	0
North Hills	530	6.7	23	60.0	0

Additional investigations were made on lead from lead service lines, faucets, hose bibs, meters, curb stopes, etc. In August 1985, a report (5) was issued by the Nassau County Department of Health with a recommendation that lead in solder be limited to 0.5 percent.

Town of Hempstead Lead Testing

The Town of Hempstead Water Department (6) collected 128 samples for lead from the water in 64 premises in all six of the Town's Water Districts. Samples were taken of the first draw water and after 60 seconds of flushing to check for lead. The higher results in this survey also point to a greater problem in newer homes and are indicated in Table 3.

TABLE 3. TOWN OF HEMPSTEAD LEAD SAMPLING

Water District	Building Age	Time Before First Draw	Lead (µg/L) 0 Min.	1 Min.
East Meadow	8 mos.	8 hrs.	2010	7
East Meadow	8 mos.	24 hrs.	1500	240
Uniondale	3 yrs.	8-10 hrs.	1049	<5
East Meadow	8 mos.	8-10 hrs.	810	<5
East Meadow	8 mos.	24 hrs.	760	380
Roosevelt Field	6 mos.	12 hrs.	569	385
Roosevelt Field	6 mos.	12 hrs.	338	<5
East Meadow	3 mos.	24-48 hrs.	186	174

WORLD-WIDE LEAD PROBLEM

During November 1982, H2M initiated an AWWA computer search of studies related to lead/lead solder. Studies have been made in the Netherlands, Scotland, England, British Columbia, Ontario, Washington (Seattle) and Carroll County, Maryland. A Medline and Toxline Computer search also uncovered lead studies in Norway, Germany and Denmark.

High lead values had been obtained in first draws of water after a period of non-use. These lead leaching values were higher with low pH's (6.4 and less) and soft water.

LEAD FINDINGS THROUGHOUT THE UNITED STATES

Others throughout the United States began to check for lead in first draw drinking water in part due to:

a. publicity during 1982 and 1983 on the lead leaching findings on Long Island,

b. a USEPA seminar on "Plumbing Materials and Drinking Water Quality" (7) in Cincinnati during May 1984,

c. three lead solder presentations at AWWA national conferences in June 1985 (8) and June 1987 (9, 10),

d. a presentation on "Impact of Metallic Solders on Water Quality" (11) at the ASCE National Conference on Environmental Engineering at Boston in July 1985.

HEALTH EFFECTS OF LEAD

The effect of lead on infants and children cannot be overemphasized. These adverse effects, which have been extremely well documented, point to afflictions ranging from anemia and colic to encephalopthy, nephropathy and neuropathy (1). Even though the elimination of lead from paints and gasoline is important, the high blood levels of lead found in children and pregnant women may not always be attributable to these sources. The University of Wales and Wharfdale General Hospital published a study in 1984 (12) utilizing a control group of 192 women, which suggested that the levels of lead in blood were more appreciably contributed by water than air. Air lead exposure from gasoline exhaust fumes (from a sampling of homes adjoining roads with approximately 40,000 vehicles per day diminishing to 27,000, 15,000 and 500 or less daily in cul-de-sacs) promoted lesser amounts of blood leads in the subjects than small amounts of lead in the drinking water. The lead in the drinking water resulted from lead water services, and primarily lead solder joints.

The 1979 New England Journal of Medicine (13) reported on the study by Dr. Herbert Needleman and others of 2,146 children and the correlation

between high dentine lead levels and their teachers' ratings of 11 negative classroon behaviors.

The 1982 New England Journal of Medicine (14) reported on the study by Dr. Herbert Needleman and others of elevated lead levels in children's shed teeth. Those children having high tooth lead levels increased by fourfold the risk of having I.Q. scores below 80.

The June 8, 1984, issue of The Journal of the American Medical Association (15) tracked 5,182 consecutive deliveries at the Boston Hosptial for Women and reported on the association of lead in the drinking water with minor birth defects.

In the literature search for medical studies on the health effects from lead in drinking water, H2M obtained the summary (16) from Stobhill Hospital/ Glasgow Health Department/Ruchill Hospital in Scotland. In comparing the water-lead levels in homes occupied by 77 mentally retarded children with those homes of 77 non-retarded children, the study indicated that water-lead content was significantly higher in the retarded group.

Pediatric Research (17) reports that the St. Louis Children's Hospital/ Washington University School of Medicine completed autopsies of 66 Sudden Infant Death Syndrome infants and 23 infants who died suddenly from other causes between the ages of 4 and 26 weeks. The infants who died of Sudden Infant Death Syndrome had 43.9 percent more lead in their livers and 68.5 percent more lead in their ribs.

The January 25, 1985, issue of the Journal of the American Medical Association (18) reported that the University of Michigan's Schools of Medicine and Public Health found increases in blood pressure, with increased blood lead levels, in black and white men and women aged 21 to 55 years.

The current 50 µg/L standard for lead has been proposed to be lowered to 20 µg/L (19), and may even be lowered to 10 µg/L. All health effects information related to lead coupled with the leaching of lead from lead solder indicated the need to study the issue and develop options for controlling lead in drinking water.

INITIATION OF THIS STUDY

In January 1983, a meeting was held with EPA personnel in Cincinnati, Ohio, to discuss the investigations and to suggest further research focusing on the effect of age, pH and hardness of the water supply on leaching from lead solder. The South Huntington Water District agreed to participate and a proposal for a cooperative study was submitted to EPA in March 1983. The "Lead solder Aging Study" was approved by EPA to commence October 1, 1983, and this report presents the results of that study.

SECTION 2

CONCLUSIONS AND RECOMMENDATIONS

Numerous studies have demonstrated that lead leaches from lead solder into drinking water. In this study, sequential samples were taken from selected homes for up to 120 seconds. Based on first draw samples, 34.9 percent of the samples exceeded the current 50 μg/L drinking water standard for lead. If the MCL was lowered to either 20 μg/L or 10 μg/L, 52.3% and 70.15% of the samples, would exceed the respective level. The 20 μg/L & 10 μg/L levels were chosen to indicate how sensitive compliance would be if the MCLs were lowered. These first draw samples were taken from 68 homes served by a public supply and 14 by private wells receiving low pH water (6.8 or less); 90 homes with a medium pH (7.0 to 7.4); and 86 homes at a high pH (8.0 and greater). The composite results are presented in Figure 4. Figure 4 indicates the increasing non-compliance as the lead standard is lowered.

There also appears to be a relationship between the age of lead solder and its ability to leach lead into drinking water. To illustrate this effect, the homes tested were categorized by age. As seen in Figure 5, the average value of lead (at ten seconds after first draw) decreases in all pH ranges as the age of the homes sampled increases. In Figure 5 the ten second sample was used to eliminate the effect of lead leaching from faucets.

An overview of the lead test results at three different pH's within the indicated ranges of first draw samples is given in Figure 6. The average alkalinity (expressed as calcium carbonate) for each pH range is indicated on the figure.

It can be generally concluded that lead leaching is reduced by age and by increasing pH and alkalinity (expressed as calcium carbonate).

PIPE LOOP STUDIES

In addition to sampling in homes, four pipe loops were constructed with 22 soldered joints per loop. Different solder types were used in each loop. The following types of solder were used: tin/lead; tin/antimony; silver/copper and tin/copper. In this test, tin/lead solder was compared to three substitute solders for metal leaching. The effect of holding time on leaching and leaching rate of various types of solder was evaluated.

On the tin/lead solder loop, the range of average (of six samples) lead values varied in each time period and, in general, decreased with an increase of pH. The loop finding for lead solder in relation to pH tends to confirm the findings from actual field testing in homes.

For the tin/antimony and silver/copper solder there was no appreciable leaching of metal. For the tin/copper solder there was a sharp decrease in copper leaching with an increase of pH from approximately 5.2 to 8.6

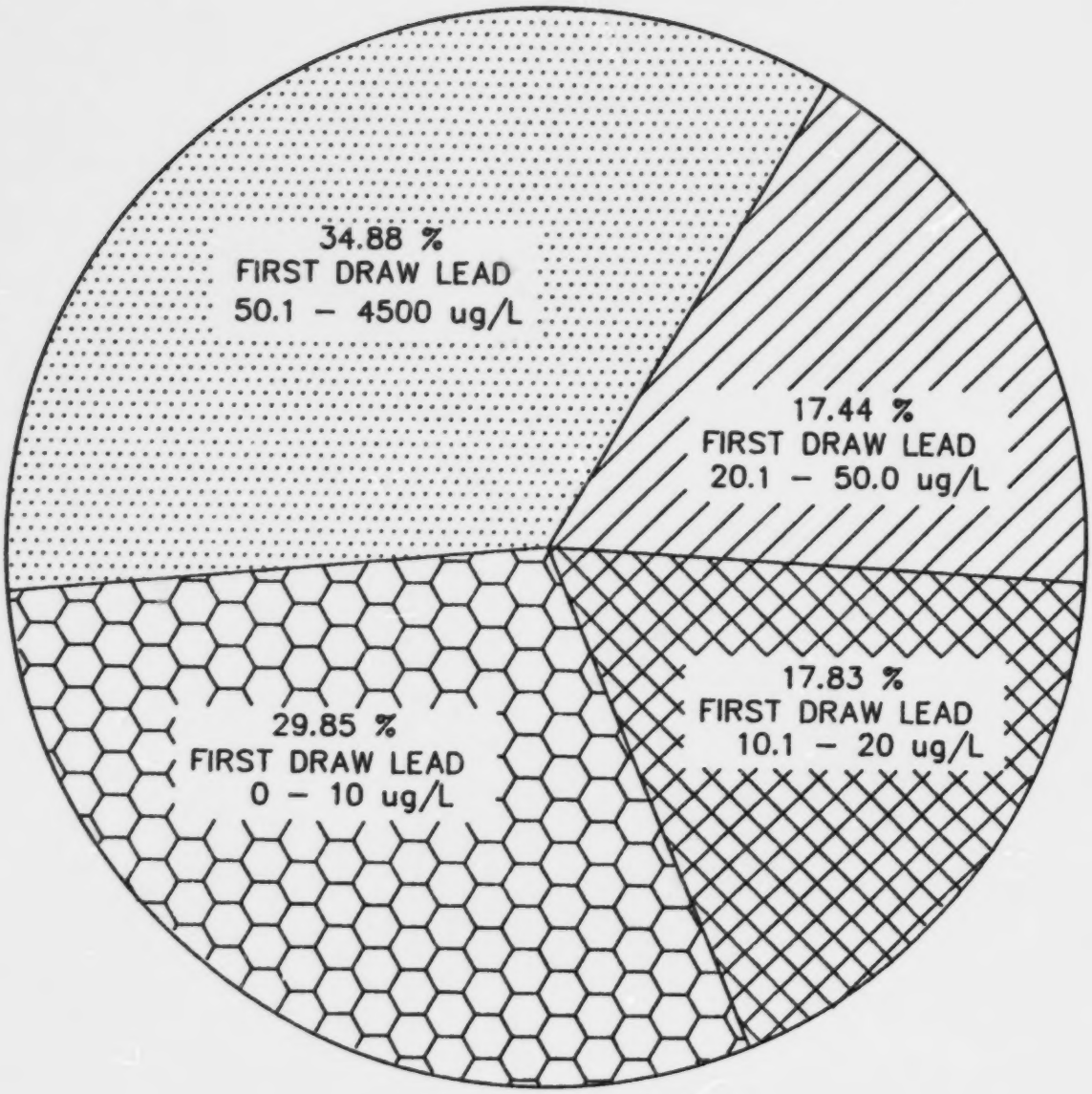

FIGURE 4. 258 FIRST DRAW LEAD TESTS AT LOW, MEDIUM AND HIGH pH

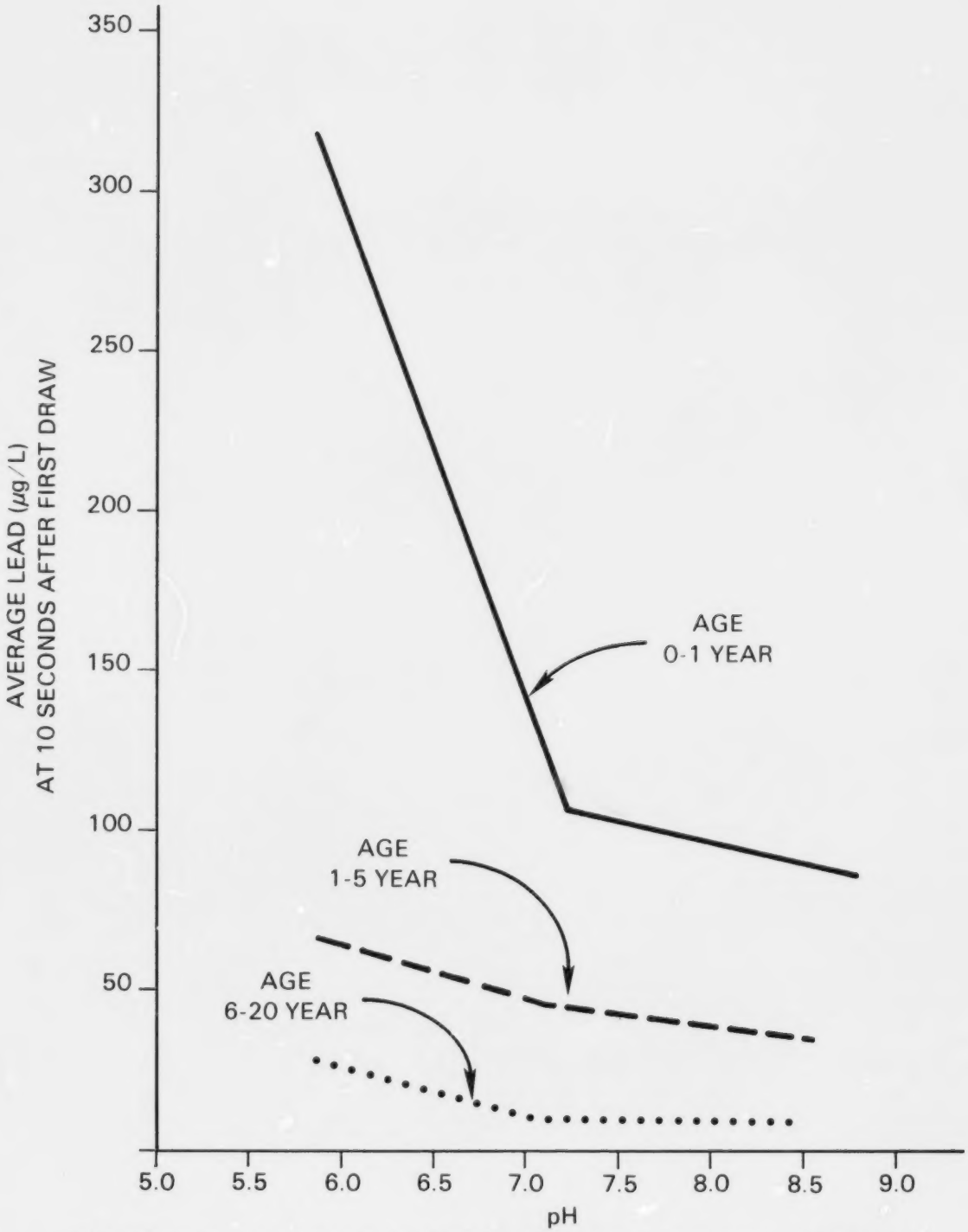

FIGURE 5. LEAD LEACHING VERSUS AGE AT VARIOUS pH LEVELS FOR 10 SECOND SAMPLES

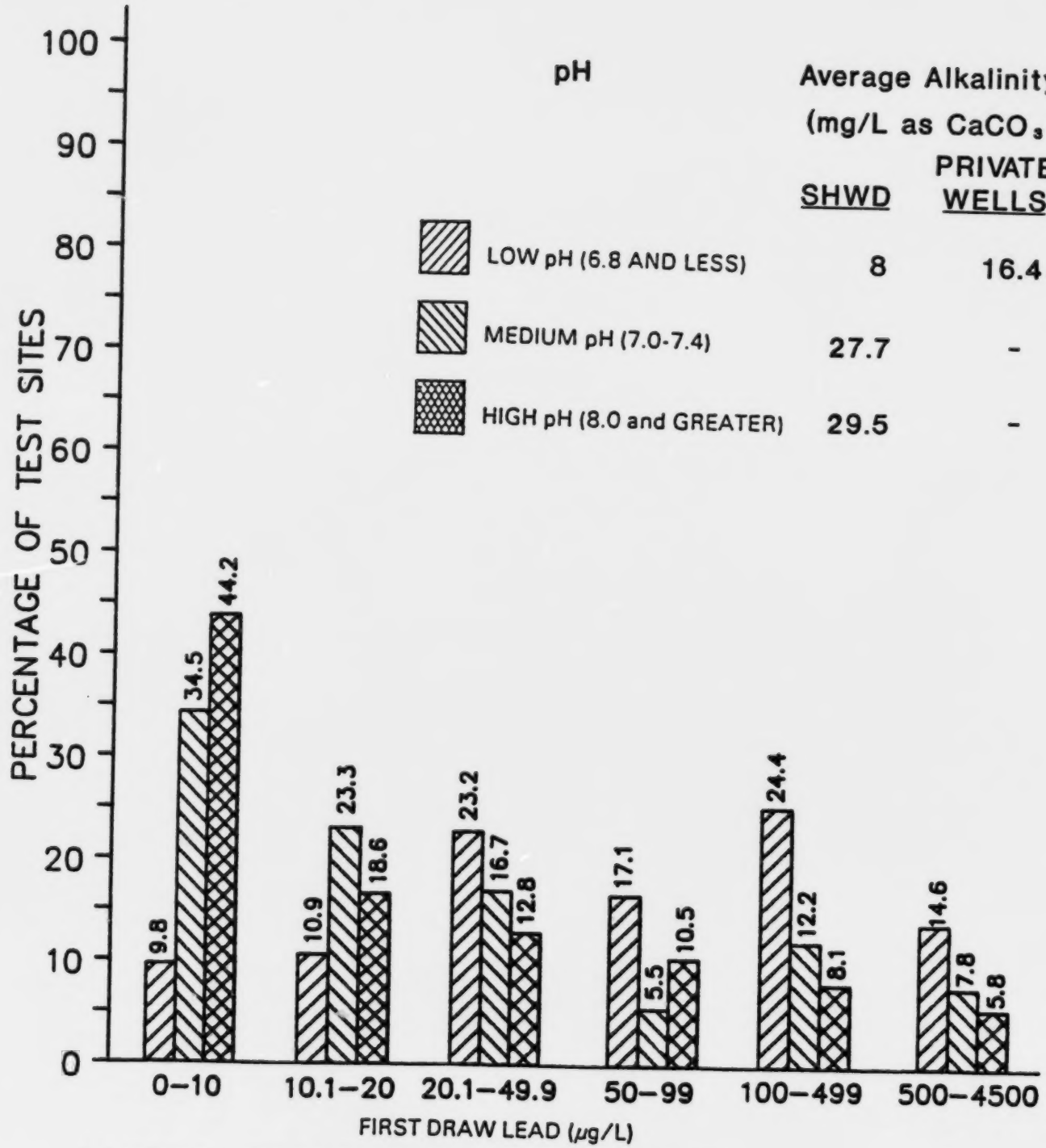

FIGURE 6. FIRST DRAW LEAD FOR 258 TESTS AT LOW, MEDIUM AND HIGH pH LEVELS

and a slight increase in copper leaching with time intervals from 4 hours to 24 hours standing time (Table 4).

TABLE 4. AVERAGE COPPER LEACHING IN COPPER LOOP STUDY IN MILLIGRAM PER LITER (mg/L)

pH	4 Hours	8 Hours	12 Hours	24 Hours
5.1-5.3	3.32	4.54	4.72	4.81
6.3-6.6	1.46	1.81	2.10	2.06
7.0-7.4	0.56	0.16	0.64	0.65
8.5-8.6	0.08	0.06	0.05	0.10

METAL LEACHING FROM FAUCETS

Lead in the first-draw sample (125 mL) may in part be caused by the faucet as has been indicated in other studies where only the faucet was tested (4). Even if this is a substantial amount, the lead found in the 10 second and subsequent time series samples confirm the leaching of lead from solder.

Of the first-draw samples in homes 31.8 percent contained less than detectable levels of cadmium. Cadmium results in the first draw water were as follows:

a. 13 homes had between 1.3 µg/L and 4.2 µg/L cadmium;
b. a home with a private well had 14.0 µg/L cadmium;
c. a home with a private well had 14.4 µg/L cadmium; and
d. homes with public water supply source had values of 35.0 µg/L at 8.3 pH and 42.5 µg/L at 5.6 pH.

Testing for first draw copper in the South Huntington Water District homes, at three different pH ranges, indicated 86.8 percent of the homes exceeded the current secondary copper MCL (1 mg/L) at pH's of 6.4 and less. Only one test in 176 exceeded 1.0 mg/L copper at pH's in the pH range 7.0->8.0.

The information obtained in this investigation clearly show that, in most cases, the first 125 mL of water contains the highest lead concentrations. Therefore, it pays to flush the pipes prior to taking a drink, expecially after overnight standing. This procedure should be carried out, even as water is being treated to reduce corrosion. Because of differences in number of solder joints, the quality of soldering and differences in water quality, the information obtained from one test site will not apply to another site. Therefore monitoring is important.

Additional Topics

More pipe loop studies should be carried out using inhibitors such as silicates and other phosphates. These studies should be done in various locations with different water quality parameters. The sites chosen for such studies should be at locations with known lead problems. The information obtained through pipe loop studies and laboratory data should then provide guidance in full-scale treatment of water going into the distribution system. Monitoring is very important in following the process of reducing lead at the consumer's tap.

SECTION 3

METHODOLOGY

In order to develop an understanding of the effects of water chemistry, plumbing system age and solder type on lead leaching, a work plan was developed to observe these effects by sampling the solder in individual homes. Since copper plumbing systems are almost exclusively connected by lead solder, the field sample was supplemented with an evaluation of specially constructed pipe loops to evaluate leaching from alternative solders.

The homes tested were in the South Huntington Water District and Suffolk County. The South Huntington Water District water supply is composed of wells that feed water to a series of storage tanks from which the water is distributed to individual homes. Household testing was conducted in three phases. Phase I consisted of selecting 63 homes in the South Huntington District and 14 households in Suffolk County served by private wells. The pH range of the water serving the homes tested in Phase I was from 5.0-6.8. In order to test the effect of pH changes on lead leaching, pH levels of the treated water were increased in two steps. Of course the pH of the private wells could not be modified so in the second phase of the test all of the homes samples were in the South Huntington District. The homes in phase II included the original 63 plus 27 more to total 90 homes. In Phase II the pH was raised to 7.0-7.4. In Phase III the pH was raised to greater than 8.0 but four households declined to participate reducing the total number sampled in Phase III to 86. Homes were selected so that approximately an equal number of homes fell into the following age categories: 0-1; 1-2; 2-3; 3-4; 4-5; 6-7; 9-10; 14-17; >20 years of age. These homes were also selected to provide a reasonable geographic distribution of the customers in South Huntington as well.

South Huntington Water District which serves 19.9 square miles obtains its water supply from various undergound formations from 18 deep wells. A map showing household locations and well sites is shown in Figure 7.

Sites selected consisted primarily of homes in the $150,000 to $500,000 price range. The median family income per census tract in 1980 ranged from $23,785 to $40,127.

A two-page letter was sent to home owners to explain the project and the need to inspect the plumbing system and then test at three different times from a water faucet that would not be turned on during the night or in the morning until after the samples were collected. Excellent cooperation was received from water consumers who allowed their premises to be used in the study.

After initial testing at low pH, each water consumer received a second letter (April 1984) explaining the results and providing lead test results. Each consumer was also advised that "we believe it would be prudent to allow

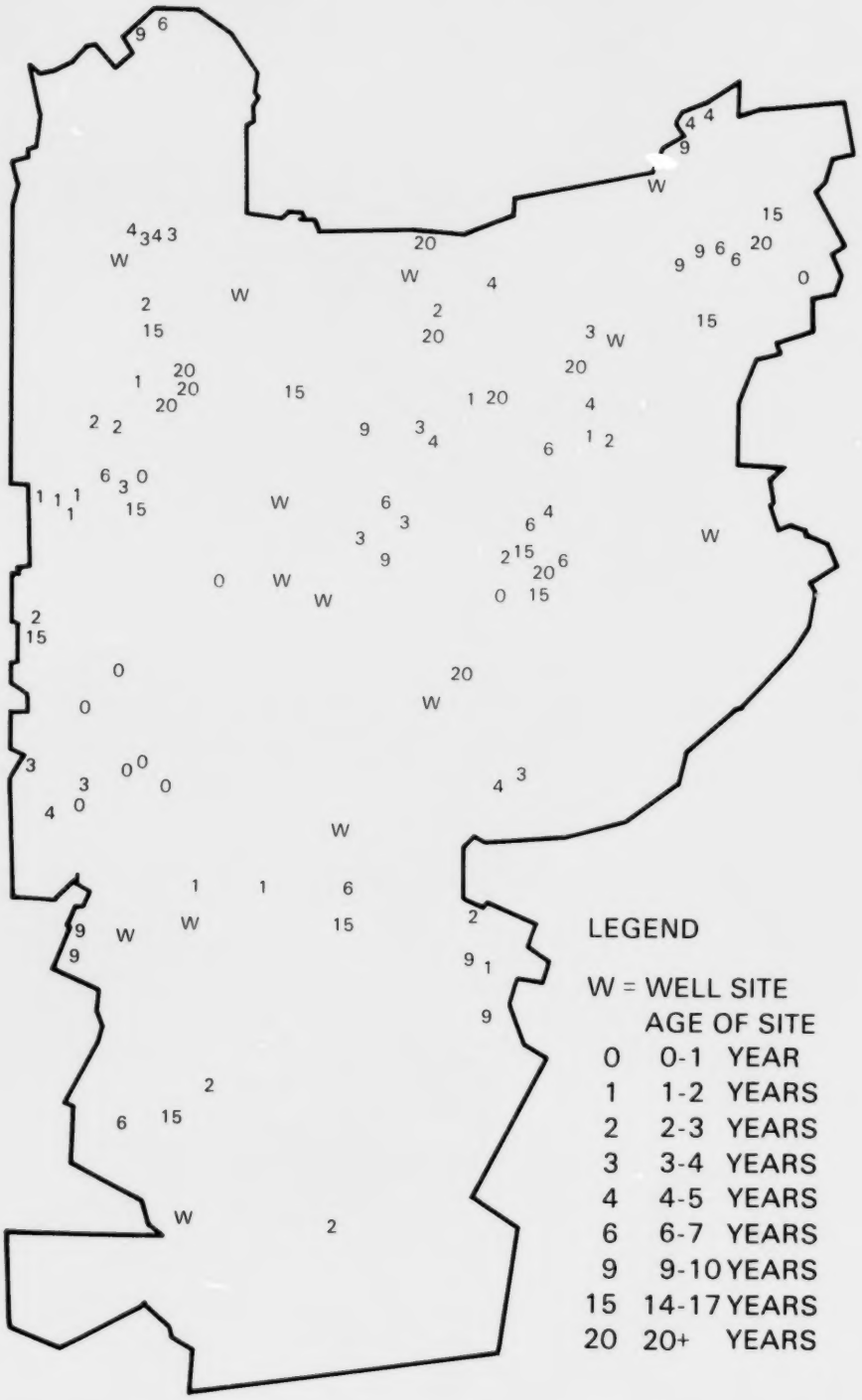

FIGURE 7. TEST SITE LOCATIONS IN SOUTH HUNTINGTON WATER DISTRICT

water to run at least a minute or two prior to first use in the morning for drinking or cooling, or after any lengthy period of non-usage".

CHECKING SOLDER IN HOMES

Prior to sampling, all homes were checked to verify that lead solder was in fact used in the household plumbing. It was relatively easy to scrape the excess exposed solder from the solder joints in the basement.

The percent lead used in solder was tested by using an atomic absorption spectrophotometer (Appendix A).

pH MODIFICATION

Long Island water is soft and naturally acidic with a pH ranging from 4.5 to 6.5. Public water suppliers normally treat this water to raise the pH to the New York State Health Department recommended pH range of 6.5 to 8.5. The Nassau County Department of Health required a pH of at least 7.5.

In general on Long Island, pH is increased by the addition of either lime, caustic soda or soda ash. The South Huntington Water District utilized caustic soda to increase the pH to the 7.0 to 7.4 range for at least thirty days prior to the second round of sampling.

Additional treatment using caustic soda by the South Huntington Water District increased the pH to 8.0 and greater for at least thirty days prior to testing in the third phase. It was difficult to hold the pH at 8 and greater due to the unbuffered water source.

SERIES SAMPLING

In order to evaluate the effects of lead leaching over time at each home, eight 125 mL samples were collected as indicated in Table 5 after first removing the faucet strainer.

TABLE 5. SAMPLING SEQUENCE

Sample Sequence	Time After First Draw (Seconds)
1	0 (first draw)
2	10
3	20
4	30
5	45
6	60
7	90
8	120

Figure 8 shows a schematic of the time series of samples that were utilized in the study. The length of time for each sample and period of time between samples is shown in Figure 8.

The sampling equipment for time series sampling is shown in Figure 9.

First draw samples were also tested for copper and cadmium. In between taking 125 mL samples (Figure 8), a quart container was used to obtain a sample to check out various water quality parameters including pH, langelier saturation index and halogen-sulfate alkalinity ratio.

PIPE LOOP

Four pipe loops were constructed as shown in the schematic in Figure 10. This loop allowed for an evaluation of tin/lead solder, as well as three substitute solders, and the evaluation of potential leaching of contaminants from all four solders.

The same plumber was used on all four loops with instructions to do a fast, normal job without being either too sloppy or too meticulous.

Piping from the source in the pipe trench to the test loop apparatus was plastic. The pipe loop was composed of copper piping and the four solders used were tin/lead, tin/antimony, silver/copper, and tin/copper. The completed test apparatus is shown in Figure 11.

Water was added at the top of the loop, held for a specific period of time, and removed at the bottom. The pH of the influent and effluent water was checked. By calculating the amount of water between joints and measuring the effluent, six 125 mL samples were obtained from each loop as near to a joint as possible. The influent and effluent ends are shown in Figure 12.

Loop Testing Procedures

1. After construction and installation of the four loops, the solder utilized was tested to verify that it was in fact the proper type for the study.

2. Each loop was flushed with approximately 100 gallons of raw water (approximately 5.1 pH). This volume of water approximates the maximum amount of water normally used by a plumber to flush a new installation.

3. To stabilize leaching conditions in the piping, water was left in each loop for four weeks. In order to obtain samples from different portions of the loop, six 125 mL samples were obtained near the solder joint in a given loop. In addition, one test in each loop was analyzed for copper, hardness, pH, alkalinity, total dissolved solids, sulfate, chloride and arsenic.

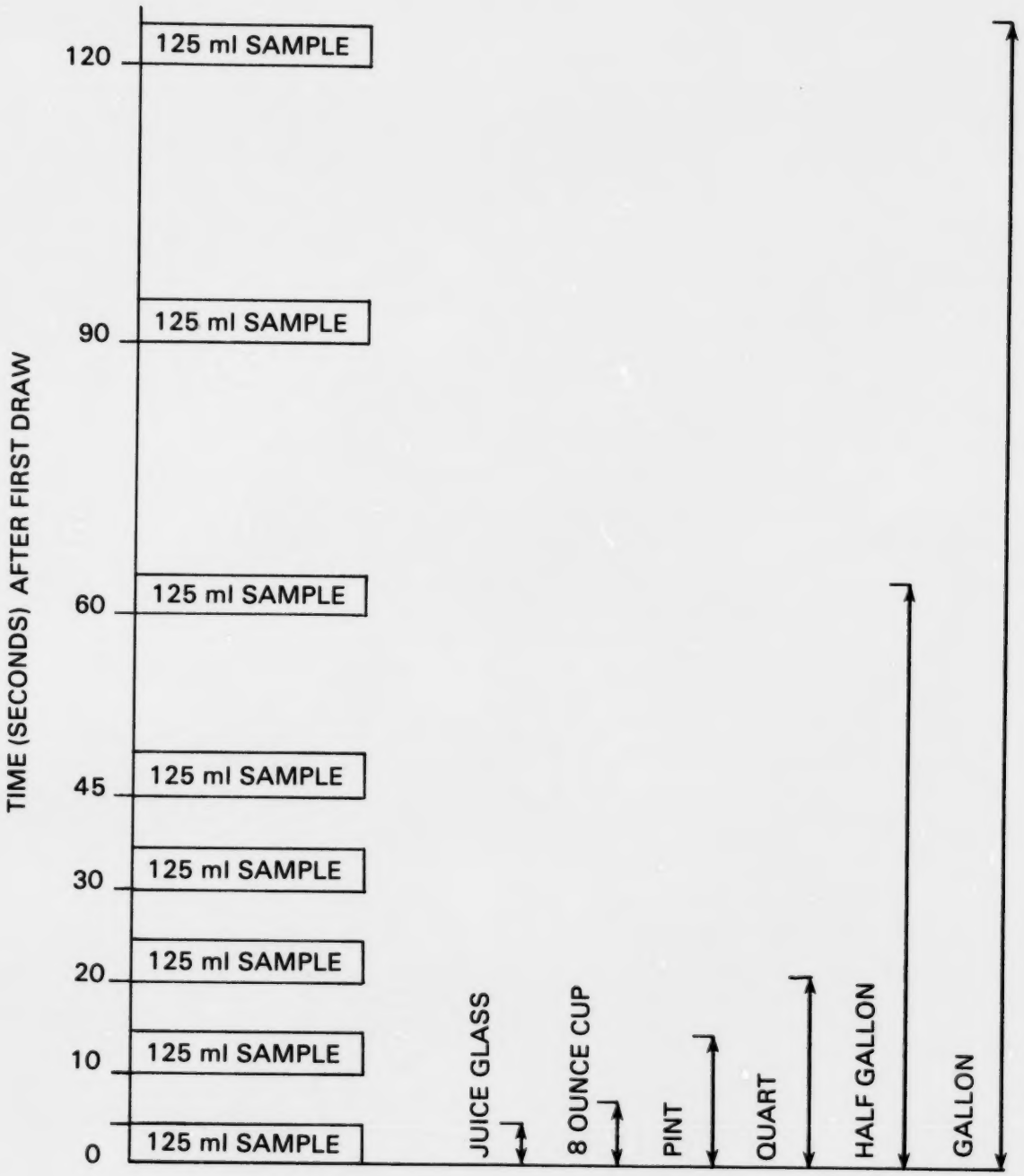

FIGURE 8. TIME SERIES SCHEMATIC AT 1800 ml/min RATE OF SAMPLING

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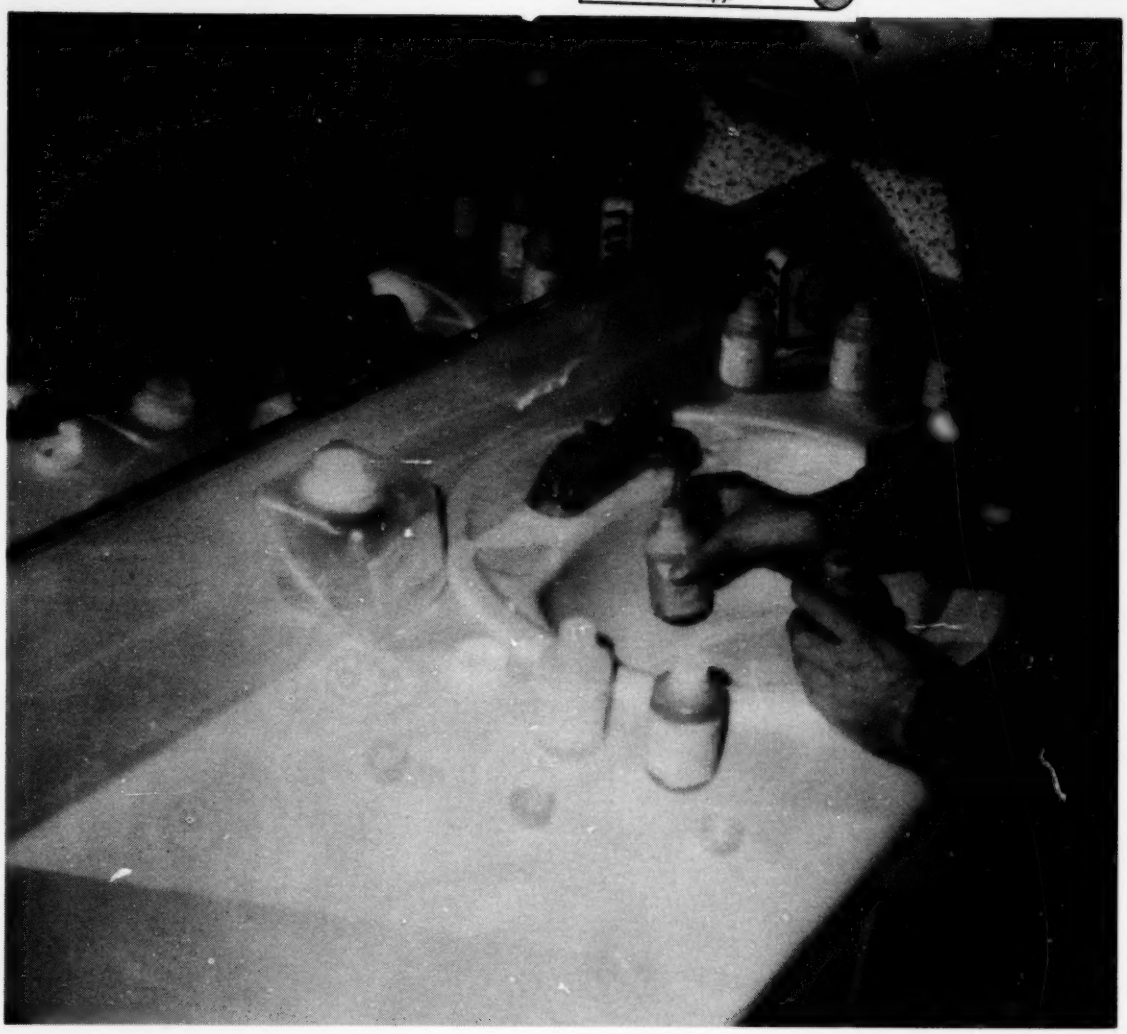

FIGURE 9. SET-UP FOR FIRST DRAW TIME SERIES SAMPLING FOR LEAD IN DRINKING WATER

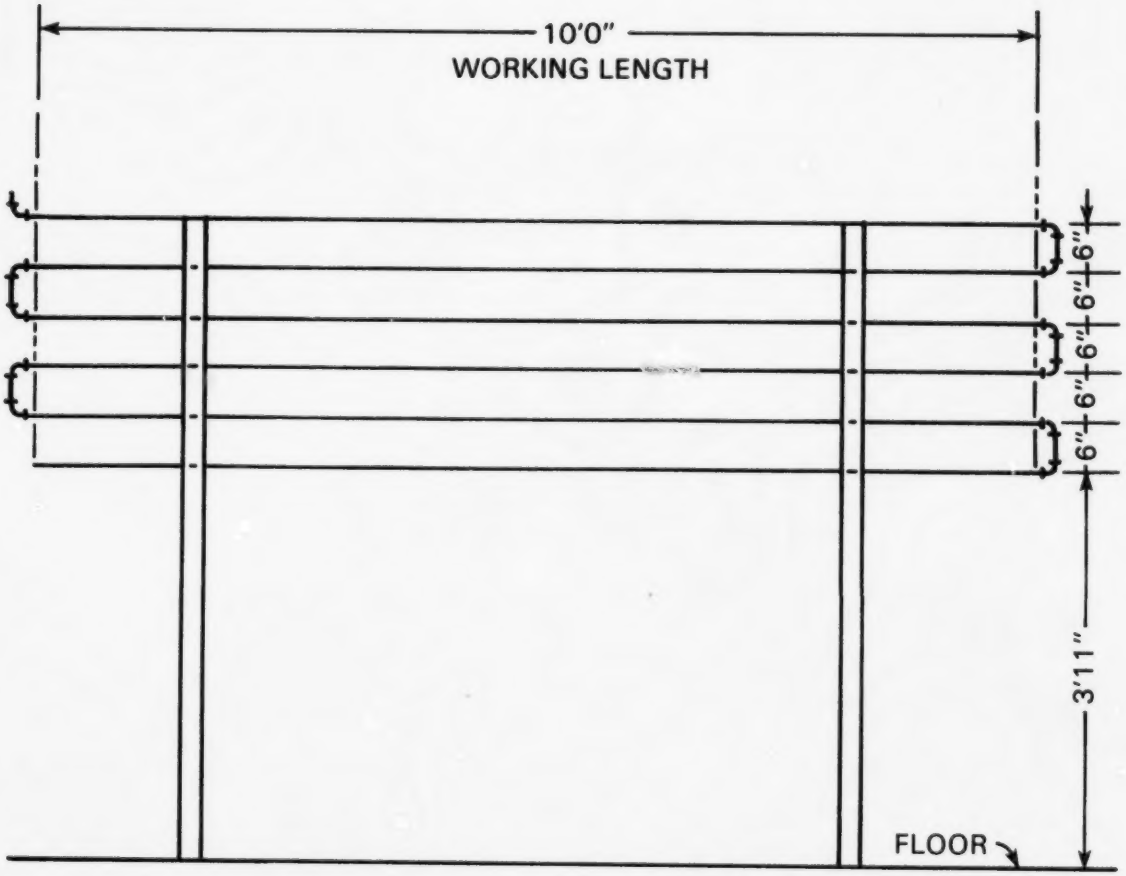

FIGURE 10. SCHEMATIC DRAWING OF TYPICAL LOOP IN FOUR LOOP STUDY

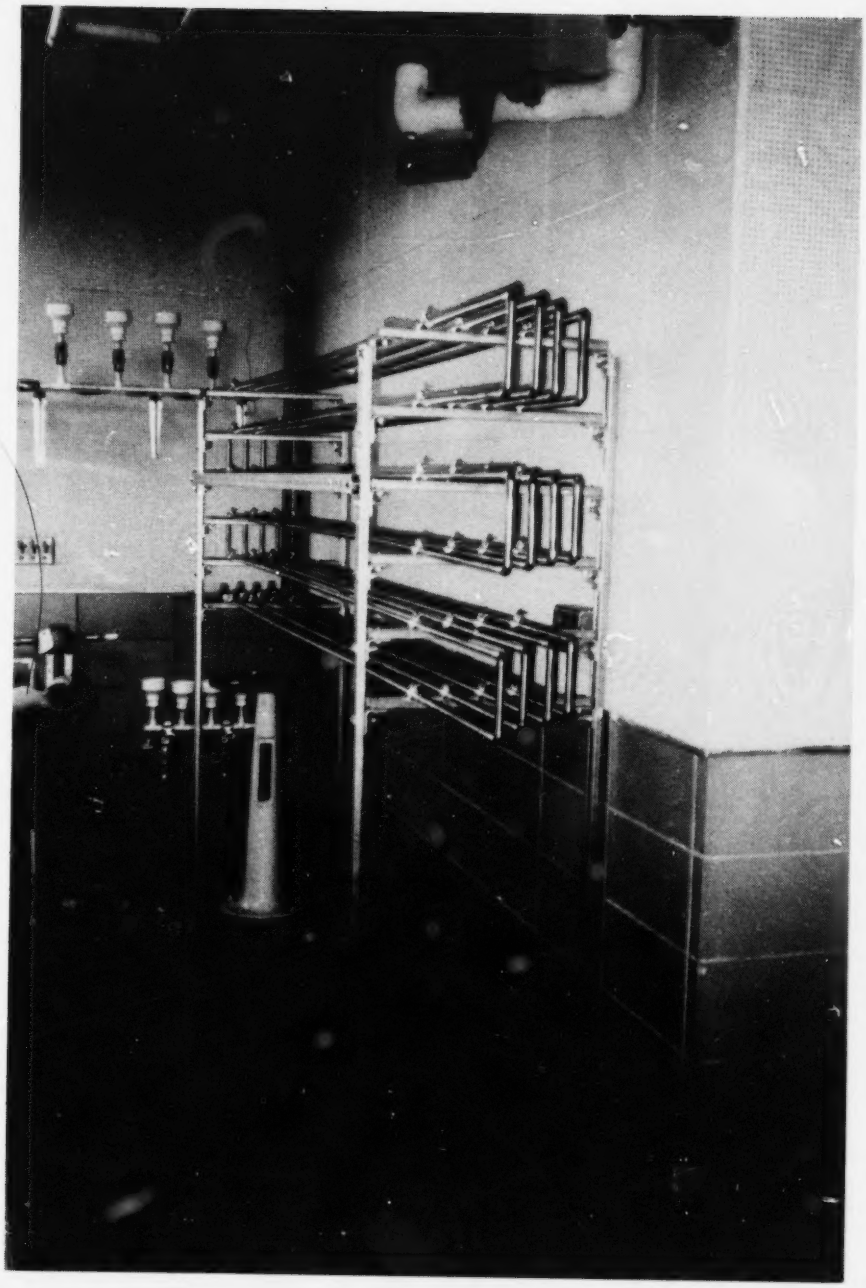

FIGURE 11. FOUR LOOP STUDY APPARATUS

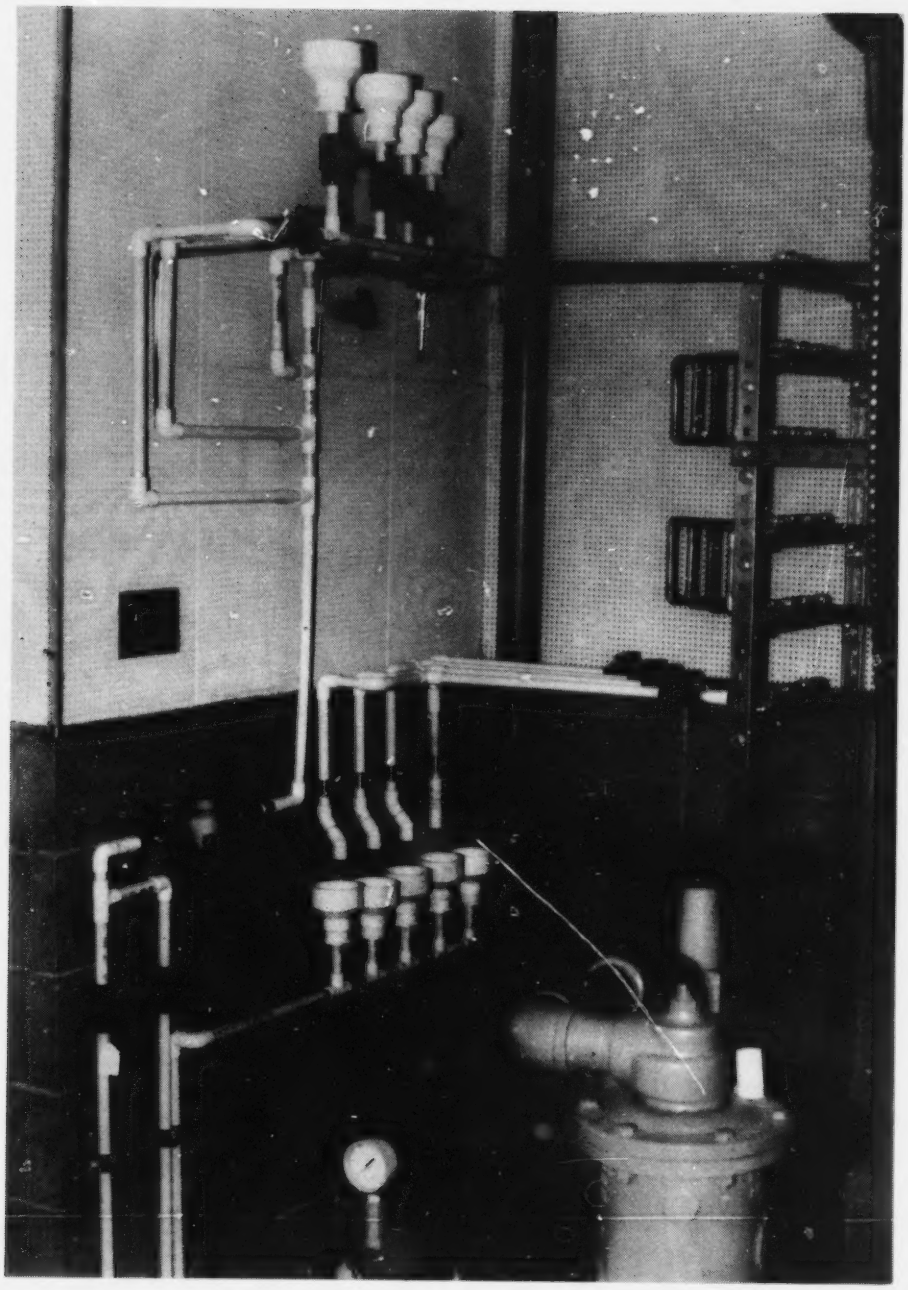

FIGURE 12. INFLUENT (TOP) AND EFFLUENT (BOTTOM) OF FOUR LOOP APPARATUS

4. Samples were taken after 4, 8, 12 and 24 hours at pH of approximately 5.1.

5. Treated water at approximately 6.5 pH (minimum recommended by the New York State Department of Health) was added to the four loops and permitted to stand for four weeks to assist in developing stabilized conditions in the piping. Samples that were than taken at 4, 8, 12 and 24 hours were then using same tests as in (3).

6. A similar approach was utilized for waters with pH of approximately 7.5 and 8.5.

7. Samples for cadmium were taken once on each loop for each pH.

8. In addition, one sample per run for lead was taken from the (antimony, silver and copper loops) for each pH.

LABORATORY METHODOLOGY

Samples analyzed from this project principally included metals (lead, cadmium, copper, antimony and silver, as well as calcium) and inorganics (pH, total alkalinity, chlorides, sulfates and total dissolved solids). The project also included analysis of various solder materials for metals (lead, tin, copper, antimony and silver - Appendix A).

The specific methods employed are outlined in the following sections.

Lead

Water samples with lead values between 0.05 and 1.0 mg/L are diluted by an appropriate amount and analyzed by "graphite furnace AA". Samples less than 0.05 mg/L are analyzed without dilution by "graphite furnace AA". Solder samples are digested in nitric acid, diluted and run by AA flame for screening and by graphite furnace if low level.

Flame Analysis (EPA Method 239.1)

The instrument is calibrated to read directly in concentration. This is accomplished by first analyzing one to three standards to establish a "calibration curve" within the instrument. The validity of this curve is verified by analyzing five standards from the detection limit to the upper end of the curve. Once validity of the calibration curve is established, samples are then analyzed by direct aspiration into the flame. The reading produced is the value for lead in milligrams per liter. Quality control checks were run as part of this procedure.

Graphite Furnace (Electrothermal Atomization) Analysis (EPA Method 239.2)

Samples for which graphite furnace analysis is necessary require a slight amount of preparation. A "matrix modifier", 1% lanthanam nitrate, is sample is recorded on a strip chart recorder and a printer. The printer records the peak height in absorbance units.

A calibration curve was prepared by plotting the peak height of blanks and standards versus concentration. The concentration of lead in the samples is determined from this curve. Specific instrument operating parameters are presented in Table A-1 (Appendix A).

SECTION 4

RESULTS AND DISCUSSION

During December 1983 and the first three months of 1984, 96 potential test homes had their household plumbing solder checked for lead content. One sample of solder was checked in each household. Only one of the 96 sites had less than 0.5 percent lead in the solder. The tin/antimony solder at this household had 0.11 percent lead content. The percent lead in the solder of the homes examined is indicated in Table 6.

TABLE 6. LEAD IN SOLDER AT TEST HOUSEHOLDS

Lead in Solder	Test Sites	
	Number	Percent
0 to 0.5 percent	1	1.04
0.50 to 39.9 percent	0	0.00
40.0 to 49.9 percent	16	16.67
50.0 to 59.9 percent	43	44.79
60.0 to 69.9 percent	35	36.46
70.0 to 79.9 percent	1	1.04
	96	100.00

Table 7 shows the percent of lead in the solder for the households tested by age of home.

Table 7. LEAD IN SOLDER BY YEAR OF CONSTRUCTION

Year of Construction	Percentage of Lead in Solder		
	Average	Median	Range
1983	56.1	58.50	46.5 - 62.2
1982	56.4	57.70	48.6 - 61.3
1981	54.5	57.90	41.9 - 62.6
1980	56.3	56.55	46.6 - 68.4
1979	58.7	60.15	48.2 - 62.3
1977	57.1	57.50	47.8 - 62.7
1974	60.8	59.75	51.8 - 73.1
1967-1969	61.5	62.60	55.5 - 66.5
1962 and Older	57.7	60.55	45.8 - 66.9

The Suffolk County Department of Health Services personnel obtained drinking water samples from 14 homes with private wells. Solder samples could be readily obtained from all but three homes. For the 11 homes where lead solder samples were obtained, the lead in the solder ranged from 42.4

to 64.3 percent with an average lead content of 56.7 percent and a median lead level of 59.4 percent.

Table 8 contains water quality values obtained during the study.

TABLE 8. WATER QUALITY PARAMETERS FOR TESTING

Parameter	Mean	Average	Range
Private Wells (pH 5.6 - 6.8)			
pH (units)	6.2	6.2	5.6-6.8
alkalinity (mg/L as $CaCO_3$)	18	16.4	6-33
Langelier Saturation Index	-3	-3.2	(-4.4)-(2.1)
Total Dissolved Solids	137.5	144.4	35-415
Chlorides - mg/L	16.5	15.5	4-32
Sulfates - mg/L	22	28.9	3-101
South Huntington (pH 6.4 & less)			
pH (units)	5.8	5.9	5.1-6.4
alkalinity (mg/L as $CaCO_3$)	7	8	1-25
Langelier Saturation Index	-4.3	-4.2	(-5)-(-3)
Total Dissolved Solids	46.5	53.8	22-131
Chlorides	3	3.3	<2-15
Sulfates	<2	0.8	<2-12
South Huntington (pH 7.0-7.4)			
pH (units)	7.1	7.1	7.0-7.4
alkalinity (mg/L as $CaCO_3$)	27	27.7	0-51
Langelier Saturation Index	-2.4	-2.4	(-3.1)-(-1.6)
Total Dissolved Solids	71	72.4	6-168
Chlorides	7	8.1	4-27
Sulfates	3	4.7	<2-27
South Huntington (pH 8.0 & greater)			
pH (units)	8.5	8.5	8.0-9.1
alkalinity (mg/L as $CaCO_3$)	28	29.5	5-46
Langelier Saturation Index	-1.0	-1.0	(-1.9)-(-0.3)
Total Dissolved Solids	154.5	130.2	8-229
Chlorides	8.5	9.6	3-21
Sulfates	3	5.0	1-17

Table 9 contains the number of homes sampled in each phase of the study.

TABLE 9. NUMBER OF HOMES SAMPLED IN EARLY PHASE OF STUDY

Age of Test Site	Phase I pH 6.8 and Less	Phase II pH 7.0-7.4	Phase III pH 8.0 and Greater
0-1	13	10	10
1-2	10	10	9
2-3	7	10	10
3-4	7	10	8
4-5	8	10	10
6-7	11	10	10
7-10	10	10	10
11-17	8	10	9
20 Plus	8	10	10
Total	82	90	86

PHASE I - LOW pH SAMPLE

In order to evaluate the effect of household plumbing age, pH, alkalinity, flushing time, etc., the number of homes exceeding 50 μg/L, and 20 μg/L, and 10 μg/L was calculated. The effect of these variables on lead leaching is presented in the following sections.

The percentage of test homes with samples exceeding both 50 μg/L and 20 μg/L is stratified by age groups in Table 10.

Table 10. PERCENTAGE OF TEST HOMES WITH RESULTS GREATER THAN 50 and 20 μg/L OF LEAD AT LOW pH (6.4 & Less)--9 AGE CATEGORIES

Lead Level in μg/L	Age Test Site (years)	Percentage of Homes							
		First Draw	10 Sec	20 Sec	30 Sec	45 Sec	60 Sec	90 Sec	120 Sec
50	0-1	100	100	100	86	67	71	71	71
	1-2	57	57	29	29	14	29	29	14
	2-3	71	43	43	29	29	29	29	29
	3-4	86	71	29	43	14	29	29	0
	4-5	57	0	14	0	0	0	0	0
	6-7	44	22	22	0	0	0	0	0
	9-10	43	14	0	0	0	0	0	0
	14-17	57	14	0	0	0	0	0	0
	20 & older	43	29	0	0	0	0	0	0
20	0-1	100	100	100	100	188	86	86	86
	1-2	100	71	86	71	57	29	43	29
	2-3	86	71	57	57	43	43	43	29
	3-4	100	86	85	71	71	71	29	43
	4-5	85	57	28	43	42	43	14	0
	6-7	78	44	33	33	11	11	11	0
	9-10	71	28	14	14	14	14	0	0
	14-17	71	14	14	14	14	14	14	14
	20 & older	86	29	28	0	14	0	14	0

From the data in Table 10 it appears that leaching levels decrease with increasing age of household. The data in Table 11 illustrates this point more clearly where the households are categorized according to 0-1, 1-5 and 6->20 years and older.

Table 11. PERCENTAGE OF TEST HOMES WITH RESULTS GREATER THAN 50 μg/L AND 20 μg/L OF LEAD AT LOW pH (6.4 & Less)--3 AGE CATEGORIES

Lead Level in μg/L	Age of Test Site (years)	Percentage of Homes							
		First Draw	10 Sec	20 Sec	30 Sec	45 Sec	60 Sec	90 Sec	120 Sec
50	0-1	100	100	100	85	67	71	71	71
	1-5	68	43	29	17	21	18	21	11
	6-20 & older	47	20	7	0	0	0	3	0
20	0-1	100	100	100	100	100	86	86	86
	1-5	93	71	64	61	54	46	32	25
	6-20 & older	77	30	23	16	13	10	10	3

PHASE II - MEDIUM pH SAMPLE

At a pH of 7.0 to 7.4 the percentage of homes exceeding 50 μg/L and 20 μg/L lead levels by age are shown in Table 12.

Table 12. PERCENTAGE OF TEST HOMES WITH RESULTS GREATER THAN 50 μg/L AND 20 μg/L OF LEAD AT MEDIUM pH (7.0-7.4)--9 AGE CATEGORIES

Lead Level in μg/L	Age of Test Site (years)	Percentage of Homes							
		First Draw	10 Sec	20 Sec	30 Sec	45 Sec	60 Sec	90 Sec	120 20
50	0-1	90	60	40	20	0	0	0	0
	1-2	50	30	10	0	0	0	0	0
	2-3	10	20	10	10	0	0	0	0
	3-4	20	10	10	20	10	20	20	0
	4-5	20	10	0	0	10	0	0	0
	6-7	0	0	0	0	0	0	0	0
	9-10	20	10	0	0	0	0	0	0
	20 & Older	10	0	0	0	0	0	0	0
20	0-1	100	90	90	60	30	20	10	10
	1-2	80	60	40	10	20	0	10	0
	2-3	30	20	10	10	10	0	0	0
	3-4	50	20	20	30	20	30	30	20
	4-5	30	10	10	0	10	0	0	0
	6-7	10	0	0	0	0	0	0	0
	9-10	20	0	0	0	0	0	0	0
	14-17	40	20	20	10	0	0	0	0
	20 & Older	20	0	0	0	10	0	0	0

The age effect is more clearly shown in Table 13.

Table 13. PERCENTAGE OF TEST HOMES WITH RESULTS GREATER THAN 50 μg/L AND 20 μg/L OF LEAD AT MEDIUM pH (7.0-7.4 & Less)--3 AGE CATEGORIES

Lead Level in μg/L	Age of Test Site (years)	Percentage of Homes							
		First Draw	10 Sec	20 Sec	30 Sec	45 Sec	60 Sec	90 Sec	120 Sec
50	0-1	90	60	40	20	0	0	0	0
	1-5	25	17	8	8	5	5	5	5
	6-20 & older	10	3	0	0	0	0	0	0
20	0-1	100	90	90	60	30	20	10	10
	1-5	48	27	20	13	15	8	10	5
	6-20 & older	23	5	5	3	3	0	0	0

PHASE III - HIGH pH SAMPLE

At a pH of 8.0 and greater the percentage of test sites exceeding 50 the μg/L and 20 μg/L levels are given in Table 14.

Table 14. PERCENTAGE OF TEST HOMES WITH RESULTS GREATER THAN 50 μg/L AND 20 μg/L OF LEAD AT HIGH pH (8.0 & GREATER)--9 AGE CATEGORIES

Lead Level in μg/L	Age of Test Site (years)	Percentage of Homes							
		First Draw	10 Sec	20 Sec	30 Sec	45 Sec	60 Sec	90 Sec	120 Sec
50	0-1	100	80	10	0	0	0	0	0
	1-2	22	11	11	11	11	0	11	0
	2-3	10	0	0	0	0	0	0	0
	3-4	13	0	0	0	0	0	0	13
	4-5	20	0	0	0	0	0	0	0
	6-7	0	0	0	0	0	0	0	0
	9-10	0	0	0	0	0	0	0	0
	14-17	33	11	11	0	0	0	0	0
	20 & Older	20	0	0	0	0	0	0	0
20	0-1	100	100	60	10	20	10	20	0
	1-2	67	22	11	11	11	11	11	11
	2-3	30	10	20	0	0	10	0	0
	3-4	25	0	0	0	0	0	0	0
	4-5	30	0	0	0	0	0	0	0
	6-7	20	0	0	0	0	0	0	0
	9-10	10	0	11	0	10	10	0	10
	14-17	33	22	11	11	0	0	0	0
	20 & older	20	0	0	0	0	0	0	0

As with the other pH levels the effect of age of household plumbing is very clearly seen in Table 15.

Table 15. PERCENTAGE OF TEST HOMES WITH GREATER THAN 50 AND 20 μg/L OF LEAD AT HIGH pH (8.0 & GREATER)--3 AGE CATEGORIES

Lead Level in μg/L	Age of Test Site (years)	Percentage of Homes							
		First Draw	10 Sec	20 Sec	30 Sec	45 Sec	60 Sec	90 Sec	120 Sec
50	0-1	100	80	10	0	0	0	0	0
	1-5	16	3	3	3	3	0	3	3
	6-20 & older	13	3	3	0	0	0	0	0
20	0-1	100	100	60	10	20	10	20	0
	1-5	38	8	8	3	3	5	3	5
	6-20 & older	21	5	5	3	3	3	0	3

pH, AGE OF HOUSEHOLD AND LEAD LEACHING

pH is a measure of the concentration of hydrogen ions (H^+) present in water and is expressed as -log (H^+). Since the hydrogen ion is the major substance that accepts the electrons given up by a metal when it corrodes, pH is an important factor in the corrosivity of water. The following table is intended to illustrate the effect of pH and age on lead leaching more clearly using the 20 µg/L cut off level.

Table 16 supports the general conclusions that increases of pH reduces lead leaching and that this effect is more pronounced in older homes.

Table 16. PERCENTAGE OF TEST HOMES WITH RESULTS GREATER THAN 20 µg/L OF LEAD

Age of Homes (years)	pH	Percentage							
		First Draw	10 Sec	20 Sec	30 Sec	45 Sec	60 Sec	90 Sec	120
0-1	6.8 & less	100	100	100	100	100	86	86	86
	7.0-7.4	100	90	90	60	30	20	10	10
	8.0 & greater	100	100	60	10	20	10	20	0
1-5	6.8 & less	93	71	64	61	53	46	32	25
	7.0-7.4	48	28	20	13	15	8	10	5
	8.0 & greater	39	8	8	3	2	5	3	5
6-20	6.8 & less	77	30	23	16	13	10	10	3
	7.0-7.4 & greater	23	5	5	3	2	0	0	0
	8.0 & greater	21	5	5	3	2	3	0	3

ALKALINITY

Low alkalinity water is reported to have a direct or indirect role in the corrosion of various metals including lead. It has been further reported that an alkalinity of 20 to 30 mg/L as $CaCO_3$ is desirable as a minimum to help form a $CaCO_3$ coating and thereby reduce corrosion (2).

Three of the South Huntington Water District wells have raw water alkalinities of 2 mg/L as $CaCO_3$ and ten have alkalinities under 10 mg/L. The untreated average alkalinity at low pH and private well sites, versus alkalinity after treatment is shown in Table 17.

Table 17. AVERAGE ALKALINITY OF WATER DURING TESTING

Location	Test Condition	Average Alkalinity mg/L as $CaCO_3$
South Huntington Water District	Low pH (untreated)	8
Suffolk County	Private Wells (untreated)	16
South Huntington Water District	Medium pH (treated)	28
South Huntington Water District	High pH (untreated)	30

Alkalinity analyses was not obtained in eight of the 258 samples conducted for lead. In the remaining 250 samples, the alkalinity in mg/L as $CaCO_3$ was subdivided into six increments of 0 through 60 mg/L, which resulted in only three tests in the 41 to 50 mg/L range and one at 51 mg/L. Although these values are reported in Table 18 for information purposes the values in these last two ranges are essentially meaningless.

Table 18. PERCENTAGE OF TEST HOMES WITH RESULTS GREATER THAN 50 μg/L AND 20 μg/L OF LEAD VERSUS ALKALINITY

Lead Level in μg/L	Time After First Draw	Percentage of Homes 0-10 mg/L	11-20 mg/L	21-30 mg/L	31-40 mg/L	41-50 mg/L	51-60 mg/L
50	First Draw	63	31	19	33	100	0
	10 sec	34	29	12	17	0	0
	20 sec	23	14	8	2	0	0
	30 sec	18	7	4	2	0	0
	45 sec	13	11	2	2	0	0
	60 sec	16	7	0	2	0	0
	90 sec	20	11	2	2	0	0
	120 sec	10	7	1	0	0	0
Number of Tests		56	28	108	54	3	1
20	First Draw	86	57	37	39	100	0
	10 sec	54	32	19	24	33	0
	20 sec	46	29	17	19	0	0
	30 sec	45	21	10	6	0	0
	45 sec	35	25	8	7	0	0
	60 sec	32	18	5	6	0	0
	90 sec	30	11	4	6	0	0
	120 sec	24	7	4	1	0	0
Number of Tests		56	28	108	54	3	1

Even with the uniqueness of each site with different workmanship by the plumber and different numbers of soldered joints clustered at different location, there appears to be a general trend of reduced leaching of lead with increased alkalinity.

FAUCET EFFECTS

Recent studies have indicated the possibility of leaching of lead, cadmium, nickel and zinc from faucets. If it is assumed that the first draw sample of 125 mL may have been partially contaminanted by the faucet, the second 125 mL sample at ten seconds after the first-draw could be utilized to determine the percentage of sites exceeding given levels of lead in drinking water.

At ten seconds after first draw, the percentage of South Huntington Water District test sites exceeding the 50 μg/L drinking water MCL for lead and 20 μg/L lead level for test sites clustered into three age groups (0 to 1 year, 1 to 5 years, 6 to 20 years and older) is given in Table 19.

TABLE 19. PERCENTAGE OF TEST HOMES WITH RESULTS GREATER THAN 50 AND 20 μg/L OF LEAD AT 10 SECONDS AFTER FIRST DRAW

Lead Level in μg/L	Age of Test (years)	Percent of Homes pH 6.8 & Less	pH 7.0-7.4	pH 8.0 & Greater
50	0-1	100.0	60.0	80.0
	1-5	42.9	17.5	2.7
	6-20 & older	20.0	2.5	2.6
20	0-1	100.0	90.0	100.1
	1-5	71.4	27.5	8.1
	6-20 & older	30.0	5.0	5.1

As with the previous analysis Table 19 shows a reduction in lead leaching with both with an increase of age of solder and increase in pH.

In the previous analysis age of solder appears to be a factor in minimizing lead leaching. This effect is examined more directly in Table 20 using the second time series sample.

TABLE 20. AVERAGE LEAD IN DRINKING WATER AT TEN SECONDS AFTER FIRST DRAW IN THREE AGE GROUPS IN THREE pH RANGES

Age of Test Site (years)	Average pH	Average Lead (μg/L)	Average pH	Average Lead (μg/L)	Average pH	Average Lead (μg/L)
0-1	6.0	318	7.2	109	8.8	85
1-5	5.9	67	7.2	45	8.6	34
6-20 & greater	5.8	26	7.1	5	8.4	6

As suggested earlier there appears to be a relationship between the increase of the age of the solder and a reduction in the leaching of lead in drinking water.

CADMIUM LEACHING

Cadmium is one of the metals that various studies have indicated as possibly leaching from faucets (20). The current Maximum Contaminant Level for cadmium is 10 μg/L, while the World Health Organization's guideline for cadimum in drinking water is 5 μg/L. A Recommended Maximum Contaminant Level (MCLG) for cadmium of 5 μg/L was proposed in the November 13, 1985, Federal Register (21).

From eight homes within the South Huntington Water District, ten first draw samples indicated cadmium above the detectable limit of 1 μg/L, with eight samples falling between 1.0 and 4.2 μg/L, as indicated in Table 21.

Table 21. CADMIUM IN FIRST DRAW SAMPLING AT SOUTH HUNTINGTON WATER DISTRICT TEST SITES

Test Site	pH 6.8 & Less Cadmium (μg/L)	pH	pH 7.0-7.4 Cadmium (μg/L)	pH	pH 8.0 & Greater Cadmium (μg/L)	pH
32 W 18	42.5	5.6	<1	7.1	35.0	8.3
125BR	4.2	5.9	2.0	7.0	<1	8.4
1 BC	2.0	6.0	<1	7.0	<1	8.9
237 MR	<1	5.6	2.3	7.3	<1	8.8
3 SS	NT	NT	1.4	7.3	<1	8.4
3 LC	NT	NT	1.0	7.2	<1	8.8
13 MS	<1	5.5	<1	7.1	2.3	8.0
36 KR	<1	5.6	<1	7.3	1.3	8.7

NT - Not Tested

Since the first draw sample at the 32 W 18 test site had a high cadmium value at a pH of 5.6, a time series samples were analyzed for cadmium. The results are shown in Figure 13.

The cadmium test results were below the current drinking water MCL of 10 μg/L cadmium after the first draw sample. It would appear from the results that the high first draw value for cadmium was caused by the faucet.

At eight of 14 private well sites, cadmium above the detectable limit (1 μg/L) was found in the first draw sample in a range between 1.3 μg/L and 14.4 μg/L. The first draw sample results and any subsequent test result after first draw in the time series are given in Table 22.

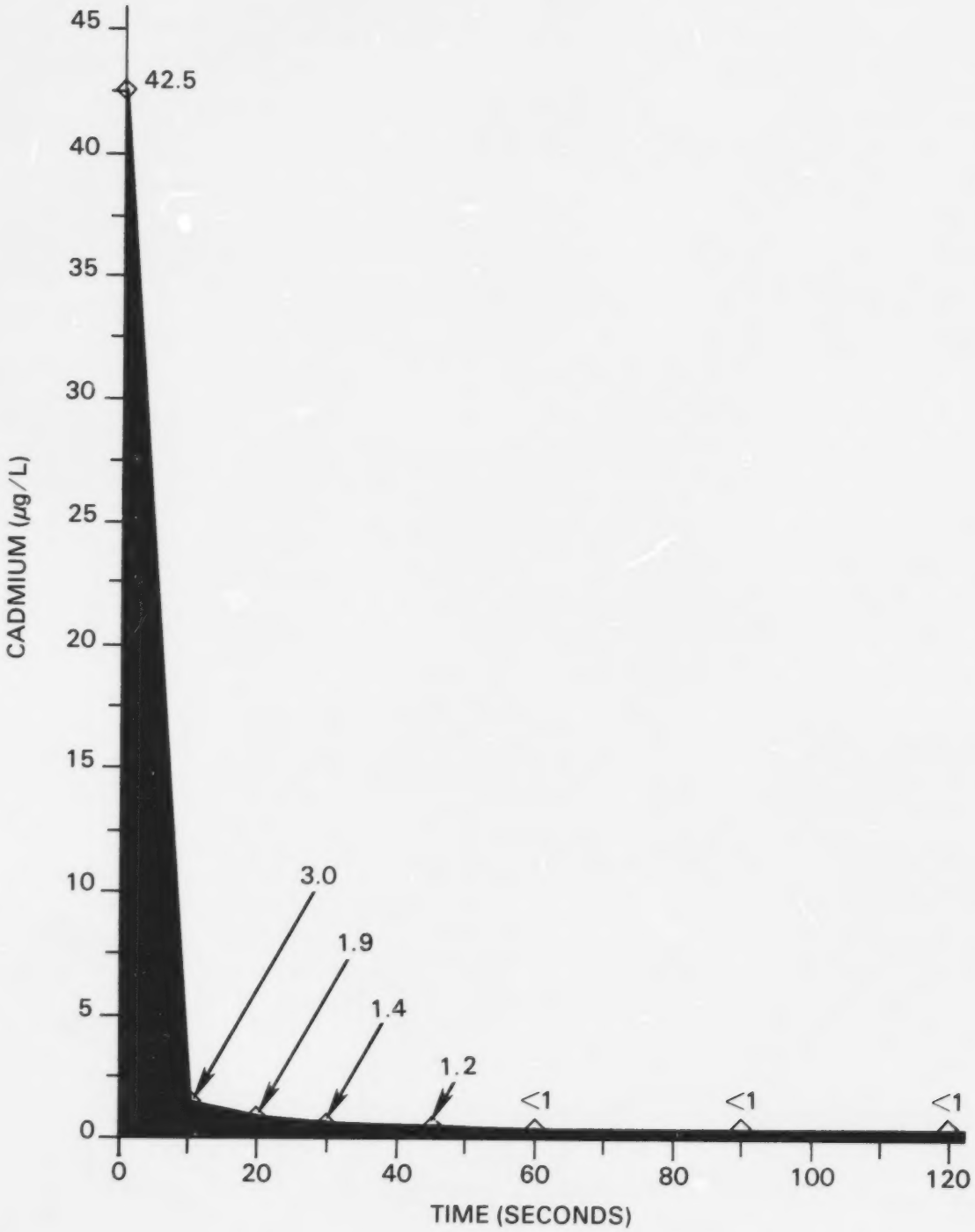

FIGURE 13. CADMIUM RESULTS AT TEST SITE 32W18

Table 22. CADMIUM IN SAMPLES AT PRIVATE WELL TEST SITES

Private Test Site	FA CA	FL WR	JS NS	AA SY	LI MD	NC WR	PA RD	SL EM
pH:	6.4	6.1	6.6	6.0	5.8	5.9	5.9	6.0
Cadmium Sample (µg/L)	Cadmium Concentration--µg/L							
First Draw	14.4	14.4	2.8	2.6	2.5	2.3	1.5	1.3
10 sec	1.5	2.0	<1	2.0	<1	<1	1.3	<1
20 sec	<1	<1	--	1.8	<1	--	1.3	--
30 sec	--	--	--	1.8	<1	--	1.3	--
45 sec	--	--	--	1.8	--	--	1.3	--
60 sec	--	--	--	1.9	--	--	1.2	--
90 sec	--	--	--	1.8	--	--	1.3	--
100 sec	--	--	--	1.9	--	--	1.3	--

COPPER LEACHING

Copper in drinking water is generally the result of corrosive water reacting with copper piping plus brass faucets and fittings. Copper corrosion may increase with low pH, low hardness and low alkalinity. This effect has been reported in other studies (20).

Copper is an essential element for nutrition at trace levels. Taste and staining problems start at about 1 mg/L of copper, and toxic effects occur at high dose levels. The current secondary drinking water MCL for copper is 1 mg/L based upon taste and odor. The World Health Organization does not have a health guideline for copper; however, they have a proposed guideline value of 1 mg/L based on the ability of copper to stain laundry and plumbing fixtures above that value. In the November 13, 1985, Federal Register, the U.S.EPA proposed a 1.3 mg/L Recommended Maxinum Contaminant Level for copper based on gastrointestinal disturbances and other acute toxic effects (21).

First Draw Copper

Copper values in the first draw samples in the South Huntington Water District plus 14 test sites with private wells is summarized in Table 23.

Table 23. COPPER (mg/L) LEVELS IN FIRST DRAW SAMPLE AT VARIOUS RANGES OF pH

Test Sites Locations	pH Range	Copper Levels in mg/L 0.0-0.49	0.5-0.99	1.0-1.30	1.31-1.99	2.0-2.99	3.0-3.99	4.0-4.99	5.0-more
Private Wells	5.6-6.8	3	3	-	2	3	2	-	1
South Huntington Water Dist	6.4 & Less	2	7	5	13	20	11	9	1
South Huntington Water Dist	7.0 to 7.4	81	9	-	-	-	-	-	-
South Huntington Water Dist	8.0 & Greater	83	2	-	1	-	-	-	-
TOTAL (258)		169	21	5	16	23	13	9	2

Note that, at pH levels of 6.8 and less in the South Huntington Water District test sites, 86.8 percent exceeded the current secondary drinking water MCL for copper, and 82.4 percent would exceed the proposed Recommended Maximum Contaminant Level for copper. At pH's of 7.0 and greater in the South Huntington Water District test sites, only one of the home sites exceeded the secondary drinking water MCL for copper. That test site had 1.79 mg/L copper at 8.3 pH, 0.10 mg/L copper at 7.1 pH, and 2.12 mg/L copper at 5.6 pH. An intermittent electrical grounding problem at this site is suspected.

STRAY ELECTRICAL CURRENTS

After finding high copper values during the initial (low pH) tests, Water District personnel checked for stray electrical currents on the water service pipe at five sites with copper in the first draw greater than 4 mg/L. Where samples were still available, the 30, 60, 90 and 120 seconds time samples were also tested for copper. The age of the site, amperage of the service line, pH and copper values based on these samples is indicated in Figure 14.

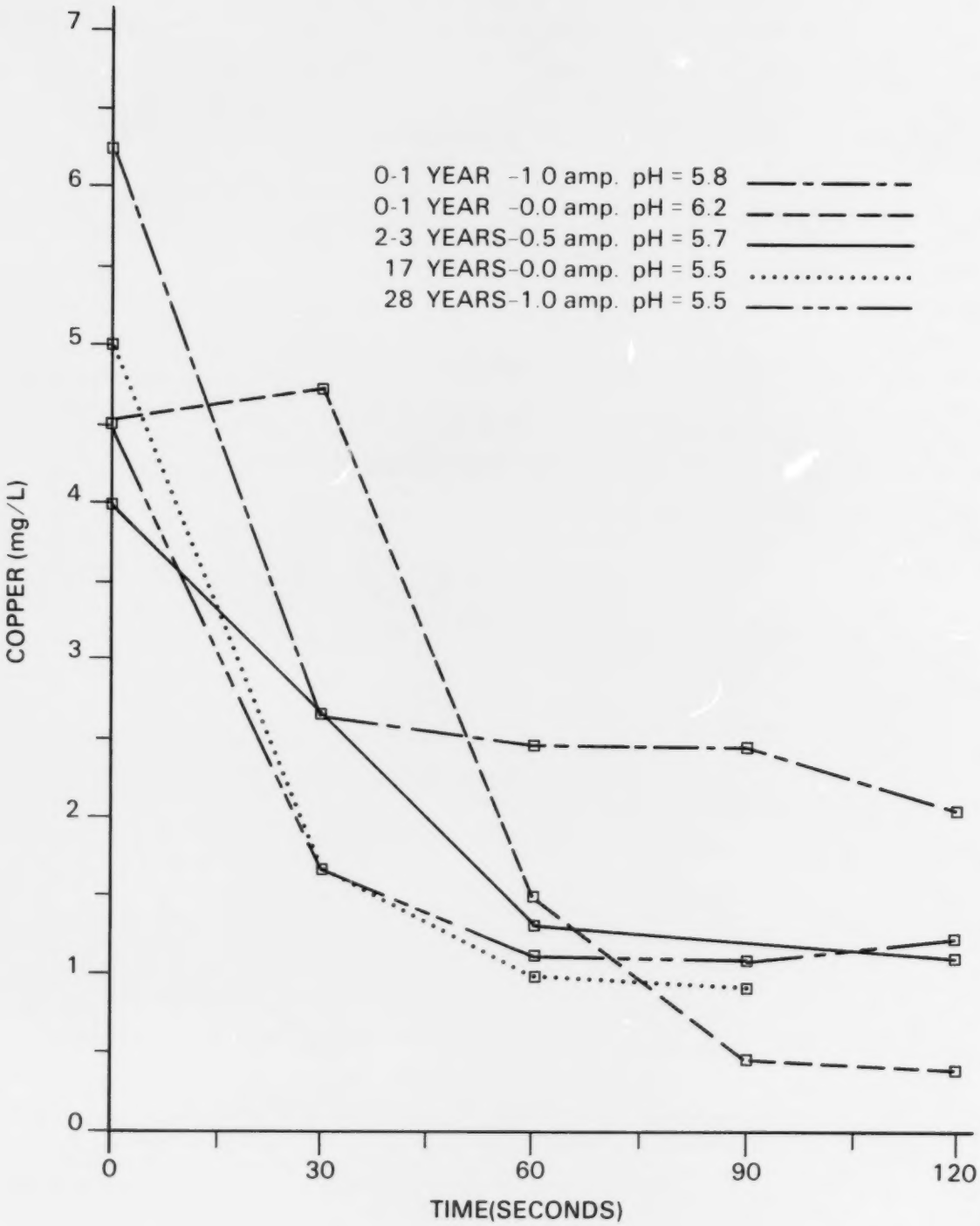

FIGURE 14. COPPER LEACHING AND STRAY ELECTRICAL CURRENTS

A definitve conclusion regarding the effect of stray currents is difficult to make based on these data. However, for the homesites in the 0-1 age category (discounting pH effects) it appears that stray current may contribute to elevated leaching levels.

PIPE LOOP STUDIES

Four loops were constructed using four types of solders to provide a means of comparing the leaching of tin/lead solder against three possible substitute solders (tin/antimony, silver/copper and tin/copper). The four control loops were constructed by the same plumber with the same number of joints at the same spacing. The same corrosive Long Island groundwater was utilized as in the home testing program. Water was left standing in the loops for varying periods of time.

Lead in Solder

The average lead content of the solders used in the pipe loop study was as follows:

a. tin/lead solder - 60.8 percent lead
b. tin/antimony solder - 0.10 percent lead
c. tin/copper solder - 0.04 percent lead
d. silver/copper solder - > 0.002 percent lead

Tin/Lead Solder

On the tin/lead solder loop, the average lead in six samples at each pH for each time period of standing water is reflected in Table 24.

Table 24. AVERAGE LEAD LEACHING IN TIN/LEAD LOOP AT VARIOUS pH's AND TIME INTERVALS

	Lead Concentration--µg/L			
Hours	pH 5.2	pH 6.4	pH 7.4	pH 8.6
24	983	322	42	15
12	933	200	28	14
8	900	169	33	7
4	752	140	12	8
2	NT	36	22	NT
1	NT	8	9	NT

NT - not tested

In a four-week time period (not shown in Table 24), the average lead was 1900 µg/L at 5.0 pH. Note in Table 24 that in all time periods of standing water except for the 1 hour sample, the lead leaching deceases

with an increase of pH. Also, in each pH range, nearly all values of lead leaching increase with time.

If a 20 μg/L MCL for lead or lower is implemented, it probably could not be met at a pH of 5.2, would be exceeded between 1 and 2 hours of standing water at a pH of 6.4, would be exceeded somewhere between 1 and 8 hours of standing water at a pH of 7.4, and probably could be met up to 24 hours of standing water at a pH of 8.6.

Highest Lead Values in Other Loops

The highest lead values in the three substitute solder loops were also determined. In the silver/copper solder loop, the highest lead in 23 loop samples was 15 μg/L lead at 5.3 pH in 4 hours. In the tin/copper solder loop, the three highest leads in 25 loop tests were (a) 42 μg/L lead at 7.4 pH in 4 hours, (b) 20.5 μg/L lead at 5.2 pH in 12 hours, and (c) 18.3 μg/L lead at 5.1 pH in 8 hours. In the tin/antimony solder loop, the three highest leads in 27 loop tests were (a) 57.5 μg/L lead at 5.3 pH in 4 hours, (b) 17.3 μg/L at 5.1 pH in 4 weeks, and (c) 11 μg/L at 5.1 pH in 8 hours.

Tin/Antimony Solder Loop

The tin/antimony solder used in constructing the tin/antimony loop contained 6.0 percent antimony, 86.2 percent tin and 0.1 percent lead.

The amount of antimony or the number of samples with less than the 4 μg/L antimony detectable limit in the six samples in each of the tin/antimony detectable limit in the six samples in each of the tin/antimony loop tests is shown in Table 25.

Table 25. ANTIMONY FROM TIN/ANTIMONY LOOP

Sampling Period (hours)	pH	Number of Samples Less than 4 μg/L Antimony	Other Results μg/L Antimony
4	5.3	6	--
4	6.3	6	--
4	7.4	6	--
4	8.5	6	--
8	5.1	6	--
8	6.4	5	5
8	7.4	6	--
8	8.6	6	--
12	5.2	6	--
12	6.4	3	4,4,7
12	7.4	6	--
12	8.6	6	--
24	5.2	6	--
24	6.6	2	4,9,14,17
24	7.4	6	--
24	8.6	6	--
(weeks)			
4	5.1	5	6
4	6.4	1	16,20,23,37,44
4	7.4	1	36,52,53,56,68
4	8.5	1	21,29.5,29.5,30,34

As noted in Table 25, most of the six samples in each tin/antimony loop were below the detectable limit of 4 μg/L antimony. There is an obvious increase in antimony that appears to start leaching at 96 hours or four days. On the abnormally long four-week period, the antimony levels appears to peak at approximately 7.4 pH.

Silver/Copper Solder Loop Test

The silver/copper solder contained 6.9 percent silver and 88.0 percent copper. The current drinking water MCL for silver is 50 μg/L with no proposed Recommended Maximum Contaminant Level listed in the November 13, 1985. Federal Register.

Twenty-three tests were conducted on the silver/copper solder loop, including four ranges of pH (5.3, 6.3, 7.4 and 8.5) and nine time intervals of standing water (four hours through four weeks). In 138 samples, only two

showed silver above the detectable limit of 2 μg/L. Two of six samples at pH 8.5 in the 12-hour standing water test indicated 104 μg/L and 3.1 μg/L of silver. The other four tests in this particular loop test were less than the detectable limit.

Tin/Copper Solder Loop Test

The tin/copper solder used in constructing the tin/copper loop contained 3.0 percent copper, 94.7 percent tin and 0.04 percent lead.

The current secondary drinking water MCL for copper is 1 mg/L based on taste and odor, and not health effects. The proposed Recommended Maximum Contaminant Level in the November 13, 1985, Federal Register is 1.3 mg/L copper based on gastrointestinal disturbances and other acute toxic effects.

The leaching of copper from both tin/copper solder and the copper piping in the loop at various times of standing is shown by Figure 15.

In the range of four hours to 24 hours, the copper leaching increases only slightly with time, but increases greatly with a reduction in pH. This pH effect confirms the findings in the field testing of first draw copper.

Six copper samples were taken in each tin/copper solder loop test. Only one sample was tested for copper in each of the other three loop tests. In general, copper leaching in the tin/lead solder loop and the tin/antimony solder loop was only slightly less than in the tin/copper solder loop. It appears that little or no copper leaches from the copper solder, and nearly all the copper leaching is from the copper piping itself.

Arsenic in Solders

There has been some recent concern regarding arsenic as a trace constituent in some solder materials. The current drinking water MCL for arsenic is 50 μg/L with the proposed Recommended Maximum Contaminant Level listed in the November 13, 1985, Federal Register to be 50 μg/L. In the four solders utilized in the loop test, there was less than detectable (<0.002 percent) arsenic in the tin/copper and tin/silver solders, 0.005 percent arsenic in the tin/antimony solder, and 0.009 percent in the tin/lead solder. Arsenic was checked for in 102 loop tests which encompassed the four different solders at the four pH ranges at periods of standing water from one hour to four weeks, and all tests results were less than the detectable limit of 2 μg/L for arsenic.

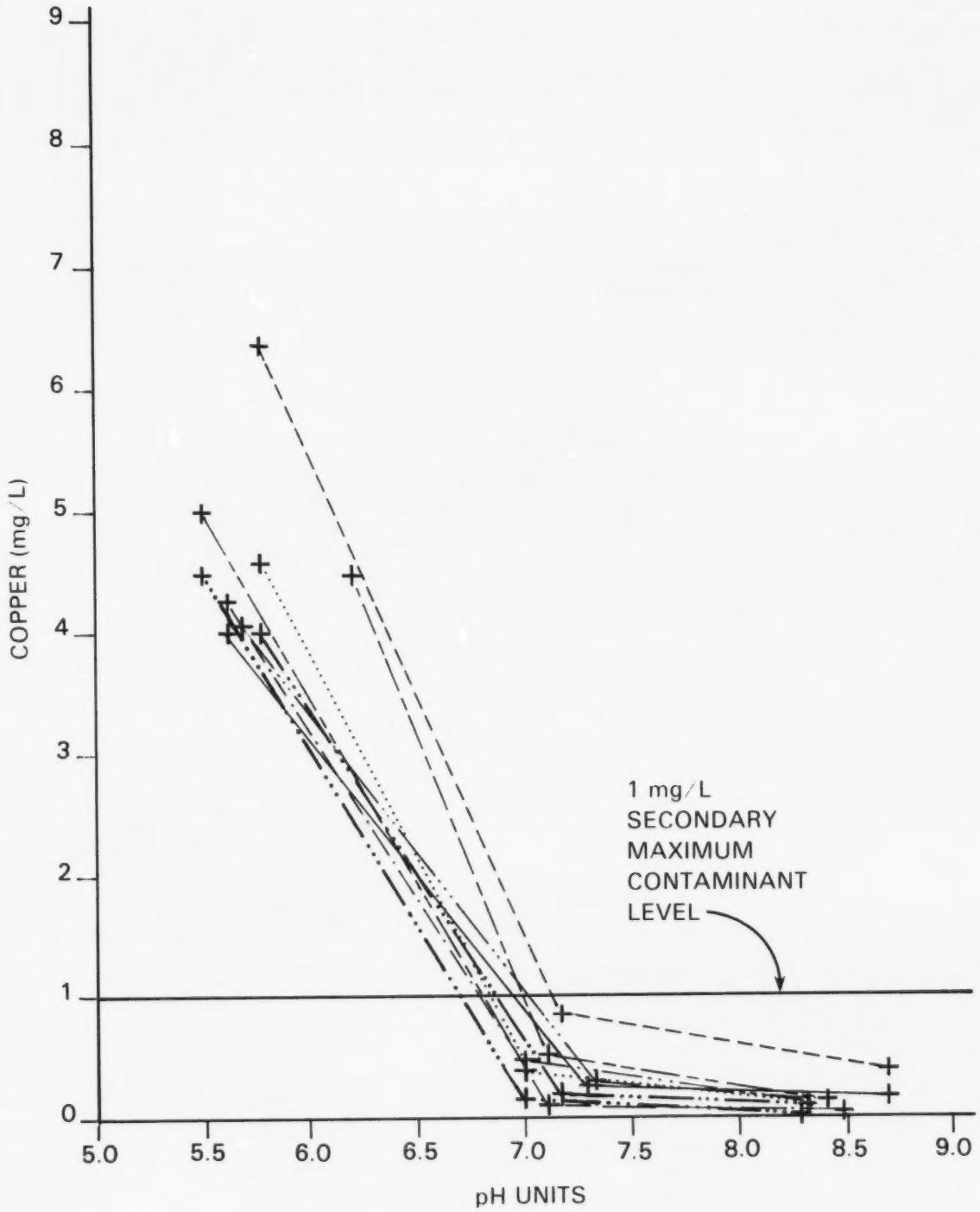

FIGURE 15. COPPER LEACHING VERSUS pH

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APPENDIX A

ANALYTICAL PROCEDURES

Calcium (EPA Method 215.1)

Instrument operating parameters for calcium analysis are presented in Table A-1. The calibration and analytical procedures are the same as for lead analysis by flame AA, except that lanthanam is added to both standards and samples to suppress interference from phosphates.

Copper (EPA Method 220.1)

Instrument operating parameters for copper analysis are presented in Table A-1. The calibration and analytical procedures are the same as for lead analysis by flame AA.

Cadmium (EPA Method 213.2)

Instrument operating parameters for cadmium analysis are presented in Table A-1. The calibration and analytical procedures are the same as for lead analysis by graphite furnace.

Antimony (EPA Method 204.2)

Instrument operating parameters for antimony are presented in Table A-1. The calibration and analytical procedures are the same as for lead analysis by grpahite furnace.

Silver (EPA Method 272.1)

Instrument operating parameters for silver are presented in Table A-1. The calibration and analytical procedures are the same as for lead analysis by graphite furnace.

Tin (EPA Method 282.2)

Instrument operating parameters for tin are presented in Table A-1. The calibration and analytical procedures are the same as for lead analysis by flame AA, except that nitrous oxide is used as the fuel.

A-1. TRACE METALS ANALYSIS CONDITIONS

Element	Wave Length (nm)	Band Width (nm)	Atomization Mode	Graphite Furnace* (Degrees C/Sec.) Dry	Char	Atomize	Calibration Standards	Detection Limit
Lead	283.3	0.7L	Graphite Furnace	125/30	500/30	2700/12	2,6,10,20,40, 50,70 µg/L	2 µg/L
Lead	283.3	0.7L	Flame, Air C_2H_2	--	--	--	0.2, 1,2,5, 10 mg/L	0.2 mg/L
Calcium	422.7	2.0H	Flame, Air C_2H_2	--	--	--	0.2, 1,5,15, 30 mg/L	0.2 mg/L
Copper	324.7	0.7H	Flame, Air C_2H_2	--	--	--	0.02,02,1, 2,5 mg/L	0.2 mg/L
Cadmium	228.8	0.7L	Graphite Furnace	125/30	500/30	1900/10	1,2,4,8, 10 µg/L	1 µg/L
Antimony	217.6	0.7L	Graphite Furnace	125/30	800/30	2700/10	4,12,20,40, 80 µg/L	4 µg/L
Silver	328.1	0.7H	Graphite Furnace	125/30	400/30	2700/10	2,6,10,20,40 50,70 µg/L	5 µg/L
Tin	286.3	0.7H	Flame, Nitrous Oxide C_2H_2	--	--	--	0.1,1,5,15, 30 mg/L	0.1 mg/L

Inorganics/Wet Chemistry

The following standard methods are used:

pH - Method 423 (Standard Methods for the Examination of Water and Wastewater, 15th Edition, 1981).

Total Alkalinity - Method 403 (Standard Methods for the Examination of Water and Wastewater, 15th Edition, 1981)

Chlorides - Method 407D (Standard Methods for the Examination of Water and Wastewater, 15th Edition, 1981

Sulfates - Method 426C (Standard Methods for the Examination of Water and Wastewater, 15th Edition, 1981)

Total Dissolved Solids - Method 209B (Standard Methods for the Examination of Water and Wastewater, 15th Edition, 1981).

Sample Preparation

No special sample preparation is necessary prior to performing any of the analyses mentioned above.

pH

Analysis for pH is performed using a digital pH meter and a "combination pH electrode". The pH meter is first calibrated with buffer solutions of known pH. Three buffers are used: pH 4.0, 7.0 and 10.0. Prior to analysis, the buffers and samples are allowed to equilibrate to room temperature. The temperature of one of the buffers is measured and the "temperature compensation" knob on the pH meter is set to the temperature of the buffer. The pH probe is then rinsed with distilled water, blotted dry and inserted in the pH 7.0 buffer. The meter is adjusted to this value. The pH 4.0 and 10.0 buffers are read on the meter. These values are recorded. If the values are within specified criteria, analysis of samples may continue. Prior to reading the pH of any sample or buffer, the pH probe is rinsed with distilled water and blotted dry. Readings are recorded when the value displayed stabilizes (or "levels off").

Total Alkalinity

The total alkalinity is determined by titrating a sample with an acid of known concentration to pH 4.5. The pH is monitored with a pH meter which has previously been calibrated.

To begin an analysis, a 100 mL aliquot (adequate for most samples) is added to a glass beaker containing a plastic coated magnetic stirring bar. The beaker is placed on a magnetic stirrer so that the sample may be stirred

during the titration. A burette is then loaded with 0.02 N sulfuric acid titrant, and an initial reading is recorded from the burette. Titrant is slowly added while the display on the pH meter is monitored. As the pH value approaches 5.0, the tirant is added more slowly until the pH value finally stabilizes at 4.5. The reading on the burette is then recorded. The difference between the final and initial burette readings times 10 (for 100 mL sample aliquots) is equal to the total alkalinity expressed as calcium carbonate. Quality control checks are interspersed with samples.

Chlorides

Method 407D in "Standard Methods", 15th Edition, is used in conjunction with a Technicon II Auto-Analyzer. Five standards in the range of 2 to 200 mg/L are prepared. Standards and a blank are transferred to the first six tubes of a 40-sample tray. Samples are placed in the remaining tubes with check standards and blanks every 15 samples. The first standard is used to calibrate a strip chart recorder directly in concentration units. The subsequent standards and blanks are used to construct a calibration curve to verify linearity. Samples are read directly off the chart recorder in concentration. Quality control checks are interspersed with samples.

Sulfates

Sulfates are measured using Method 426C in "Standard Methods", 15th Edition. This is a turbidimetric procedure, the sulfate concentration being proportional to the turbidity produced. To a 250 mL Erlenmeyer flask, 100 mL of sample (or a smaller volume made up to 100 mL) is added. To this, 5 mL of conditioning reagent is added. While stirring, one scoop of barium chloride crystals is added and stirring is continued for one minute. The maximum reading on the nephelometer during the next four minutes is recorded.

Five standards in the range of 0 to 40 mg/L were prepared and measured in the same manner as the samples. A standard calibration curve of percent transmittance versus concentration is plotted on rectilinear graph paper, since the output from the nephelometer is linear with respect to percent transmittance. A sample blank from which the barium chloride is withheld is used to correct for turbidity present in the original sample. The concentration of sulfate in the sample is determined from the calibration curve. Quality control checks are interspersed with samples.

Total Dissolved Solids

Total dissolved solids are determined using Method 209B (total Filterable Residue) in "Standard Methods", 15 Edition. A measured volume of sample which has been filtered through a glass fiber filter (GFA) is added to a predried and tared beaker. The sample is evaporated at 103 degrees Centigrade to dryness, and is then further dried at 180 degrees Centigrade for at least one more hour. The sample is cooled in a desiccator and

weighed. The drying, cooling, and weighing cycle is repeated until a constant weight is obtained. The result is reported in mg/L.

Internal Quality Control Checks

Internal quality control checks are employed to ensure that test operations function within expected accuracy and precision, and that the method is applicable to the sample being analyzed. Five percent of all samples are analyzed in duplicate for precision, and five percent of all samples are spiked for accuracy.

Significant Figures

Throughout this report, considerable data, particularly on lead, is presented. In order to avoid distortions created by the rounding effects for comparison and interpretation of compliance with existing and proposed MCL's, the custom on significant figures has been slightly modified.

For example, lead data have been presented for values greater than 10 μg/L in the format, XX.X μg/L, implying that there are three significant figures. In fact, the analytical method would allow for only two significant figures. Below 10 μg/L, one significant figure would be appropriate for lead based upon the analytical method.

APPENDIX B

This Appendix contains the detailed results from the individual homes sampled. The dotted line drawn across the tables indicates those homes for which the complete times series could not be obtained.

TABLE B-1. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1983 CONSTRUCTED TEST SITES (0-1 YEAR)

pH 6.4 and less

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
21 EC	6.2	1200	900	600	188	--	84	81	66.5
237 MR	5.6	1100	185	200	110	80	84	109	92
35 HD	6.2	900	198	94	38	25	16	14	15
7 SL	6.2	860	325	370	440	580	700	205	66
17 KR	5.8	600	400	350	365	260	131	91	110
277 RS	6.3	500	118	100	62	45	28	22	40
170 CR	5.9	84	100	133	200	235	250	145	133
205 MM	6.1	600							
20 EC	6.3	300							
1 BC	6.0	500							

TABLE B-2. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1982 CONSTRUCTED TEST SITES (1-2 YEARS)

pH 6.4 and less

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
116 OC	6.4	900	64	53	36.5	38.5	84	160	45
37A CD	6.1	745	72	32	23	14.5	12	9.5	7
14A HL	5.8	505	210	255	218	250	180	124	78
15 EA	5.9	165	129	40	68	22	16	13	13
94 EA	6.1	45.5	13	42	15	6.5	7	3.5	4.5
34 E22	5.8	34	24	22.5	25	25	20	21	10
4 LC	5.8	32	10	7	10	7	14	9.5	4.3

TABLE B-3. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1981 CONSTRUCTED TEST SITES (2-3 YEARS)

pH 6.4 and less

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
10 RS	6.4	280	46	24	22	31	44	31	19
8 CL	5.7	205	45	52	21.6	16.8	11.6	9.8	6
W 16	5.8	165	115	160	92	98	118	136	138
125 BR	5.9	146	85	120	74	96.4	72	70	91.6
83 MH	6.0	98	73	17	9	8.5	8	4	5
178 OS	5.7	30.8	20	19	<2	18.5	8.9	7.2	6.6
17 LP	5.8	12	6	3.2	4.2	8.2	6.5	6.4	6.5

TABLE B-4. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1980 CONSTRUCTED TEST SITES (3-4 YEARS)

pH 6.4 and less

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
71 NS	5.7	355	65.6	48	27.6	20.8	21.3	16	15
13 TC	6.3	225	450	395	318	146	100	86.4	47.6
8 MC	5.9	190	74	32	20	16	17	11.5	7.5
21 LS	5.9	106	82	32	26	23.5	21	18	16
266 E17	5.8	100	85	55	28	58.5	25	55	11.5
12 MD	5.6	74	44	36	30	51	36	19	22.5
4 ML	5.7	21	8.5	17.5	4.5	16	20	9	29

TABLE B-5. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1979 CONSTRUCTED TEST SITES (4-5 YEARS)

pH 6.4 and less

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
40 E15	6.0	315	37	71	38.5	24.5	48.5	24	13
5 HD	5.8	215	30	20	17	15	17.5	13	6.5
12 MS	5.7	91	22	18.4	17.6	<2	<2	9	12.5
32 MD	5.7	65	31	30	22.5	12	10	8	6.5
8 SC	5.6	27	17	5	3	2	2.5	<2	<2
6 KC	6.0	26	10	8.5	7	21	27	3.5	5.5
53 LD	6.3	20	15	13.5	43	41	26	9	5

TABLE B-6. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1977 CONSTRUCTED TEST SITES (6-7 YEARS)

pH 6.4 and less

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
104 DA	5.8	261	52.5	34.8	24.5	18.2	12	13.2	11
39 WS	5.5	100	170	148	25.2	14.5	15.7	16	16.5
12 SM	6.2	94	31	12	11	8	10	8.5	6.5
6 EA	5.6	82	44	58	32	28	24	17	16.5
13 MS	5.5	47.5	7	4.5	3.5	2	2	4	<2
10 RA	6.2	32	3.9	4	3.2	3.8	2.6	5	18
3 MC	5.7	15	10.5	10	6.5	7.5	14.5	86	7
44 BA	6.4	15	<2	<2	<2	<2	<2	<2	<2
7 HA	5.1	34	7	6.1	4.2	3.8	8.5	2.5	6

TABLE B-7. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1974 CONSTRUCTED TEST SITES (9-10 YEARS)

pH 6.4 and less

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
7 FC	5.7	235	54	29.5	25	24	21	17	16.5
14 GW	6.0	76	34.5	15	10	9	7	2	3
25A ES	5.9	65	8.8	5	4.9	5.2	3	4.6	6.6
22 BA	6.3	48	8	6.5	6	5	4.5	2	2.1
6 SM	6.4	36	10.5	3.5	<2	<2	<2	2	<2
10 OO	5.7	16	3.8	1.5	5	3	3.5	2	<2
17 KS	6.3	6.5	4.9	3	4.8	3.8	6.5	3.7	2.8

TABLE B-8. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1967-69 CONSTRUCTED TEST SITES (14-17 YEARS)

pH 6.4 and less

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
72 BA	5.9	1300	86	44	44	40	39	34.5	36
32 CS	5.6	225	14.5	9	16.5	9.3	11	12.5	10
36 KR	5.6	172	13.9	7.4	4.9	2	<2	<2	<2
10 PR	5.3	108	9	6.7	7.7	8.3	8.2	9.5	6.7
34 RA	6.3	27	12.5	5	6.3	<2	<2	6.2	4.2
183 MR	5.6	7.6	3.1	5	6.6	7	9.2	6.8	7.9
1 MC	5.9	<2	3	<2	<2	<2	<2	<2	<2

TABLE B-9. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1952-62 CONSTRUCTED TEST SITES (20 YEARS +)

pH 6.4 and less

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
2 HA	5.5	175	71.4	26.1	19.6	10.1	17.0	13.2	9.2
39 RS	5.8	88	10	8.6	7.3	5.8	5.8	5.5	5
31 SS	5.7	80	11	6.1	4	3	4.5	4.2	4.1
32 W18	5.6	48.5	51	28	17	15	13	10	12
247 NY	5.7	40	16	12.3	11.6	11	10.5	16	13.4
13 HH	6.0	23	8	4	3	4.7	2.5	6	<2
44 CS	5.6	16.2	16	9.6	7.1	30.6	18.8	20.8	6.1

TABLE B-10. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1983 CONSTRUCTED TEST SITES (0-1 YEAR)

pH 7.0 - 7.4

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
21 EC	7.0	37	15	33	14	6	4	9	19
237 MR	7.3	1800	255	225	88	30.7	23.2	11.9	15.6
35 HD	7.2	140	29.4	13.3	<2	6	6.7	6.9	<2
7 SL	7.1	520	43.3	136	59.3	30.7	34.8	72.8	50
17 KR	7.2	630	85	38	18	12	11	8	8
277 RS	7.0	148	220	195	35.3	19	14	9.8	7.8
170 CR	7.4	130	78.5	25.6	25.6	14.5	15.1	13	14.3
205 MM	7.4	187	22.5	80	45	37.8	10.5	17.9	<2
20 EC	7.1	547	210	22.7	19.8	11.4	14	12	11.5
1 BC	7.0	261	126	23.8	22.5	15	10.6	10	6.8

TABLE B-11. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1982 CONSTRUCTED TEST SITES (1-2 YEARS)

pH 7.0 - 7.4

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
116 OC	7.1	38	15.5	13.2	10.5	10	7.5	6.9	9.9
37A CD	7.4	360	48	37	18.5	26	<2	27	15
14A HL	7.0	355	60	34.5	48	21.5	18	15	14
15 EA	7.2	40	67	52.5	19	16.2	11.8	7.3	8.2
94 EA	7.3	34.3	6.9	4.8	3.5	3	3.2	4	2.8
34 E22	7.1	12	9.5	10.5	7	7	5	4.5	4
4 LC	7.2	12.2	3	<2	<2	<2	<2	<2	3.2
88 OC	7.1	89	38	26.5	19	13	12	15	10.5
20 GS	7.2	195	32	15	9	7	6	5	4.5
3 LC	7.2	1000	73.5	17.8	8.7	6.5	6.9	6.8	4.5

TABLE B-12. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1981 CONSTRUCTED TEST SITES (2-3 YEARS)

pH 7.0 - 7.4

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
10 RS	7.1	16.7	16.7	6.2	3.9	2.9	<2	2	4.1
8 CL	7.3	33	7	8	7.5	3	3	<2	<2
W 16	7.2	8.1	56	5.5	3.8	<2	<2	<2	2.5
125 BR	7.0	20	6.1	10.3	8	8.4	13.2	11.2	9.9
83 MH	7.1	<2	<2	<2	<2	<2	<2	<2	<2
178 OS	7.1	7	6	3.3	3	<2	9.5	<2	<2
17 LP	7.4	9	4	3.5	3	3	2	2	<2
510 BH	7.3	550	1000	310	104	42	9.5	4.5	3
16C CS	7.0	21	2	2	<2	<2	<2	<2	<2
444 JT	7.1	<2	3.8	<2	<2	<2	<2	<2	<2

TABLE B-13. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1980 CONSTRUCTED TEST SITES (3-4 YEARS)

pH 7.0 - 7.4

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
71 NS	7.3	20	49.8	19.7	60	19.7	65.5	74	29.2
13 TC	7.0	71.8	14	21.3	54.7	49	36	23	19.8
8 MC	7.1	32	9	6	6	5.5	4	4.5	5.5
21 LS	7.0	14	10	4	4	3	<2	3.5	<2
266 E17	7.0	9.6	<2	<2	<2	<2	<2	<2	<2
12 MD	7.0	11	3.9	<2	<2	<2	4.1	<2	3.1
4 ML	7.2	34.2	14.5	3.5	5.8	4	3	6.1	3.8
WJ PT	7.0	14	8.5	12	6	<2	<2	<2	<2
28 MD	7.0	300	77	4400	31	186	104	68.4	47
274 RS	7.2	24	<2	<2	2	2	<2	<2	5

TABLE B-14. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1979 CONSTRUCTED TEST SITES (4-5 YEARS)

pH 7.0 - 7.4

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
40 E15	7.0	13.2	12.2	3.3	2	<2	<2	<2	<2
5 HD	7.0	19.7	3.9	<2	<2	<2	<2	2.5	2.4
12 MS	7.0	13	<2	<2	<2	<2	<2	<2	<2
32 MD	7.2	25.3	5.5	3	5.5	2.1	2.2	2	<2
8 SC	7.1	8	<2	<2	<2	4	<2	<2	3
6 KC	7.4	<2	<2	<2	<2	<2	<2	<2	<2
53 LD	7.3	4	4.6	3.9	2.1	73	<2	5	<2
34 HA	7.2	463	11.5	9.5	8.7	6	5	6.1	9.3
25 WA	7.2	53.6	94	26.9	14	10	9	<2	6.1
7 KC	7.3	19	7.5	14	6	7	5	4	8

TABLE B-15. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1977 CONSTRUCTED TEST SITES (6-7 YEARS)

pH 7.0 - 7.4

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
104 DA	7.1	44	7	7	6	4	4	3	<2
39 WS	7.1	8	2	<2	<2	<2	<2	<2	<2
12 SM	7.0	8	4	<2	<2	<2	<2	<2	<2
6 EA	7.2	5.5	3	3	2	3	<2	<2	<2
13 MS	7.1	4.6	<2	<2	<2	<2	<2	<2	<2
10 RA	7.2	6	<2	<2	<2	<2	<2	<2	<2
3 MC	7.2	11	2.1	<2	<2	<2	<2	<2	<2
44 BA	7.0	9	<2	<2	4	2.8	3	<2	2
45 RS	7.3	18.7	3.5	2.6	<2	<2	<2	<2	<2
46 BA	7.1	6.5	3	4	<2	<2	<2	<2	<2

TABLE B-16. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1974 CONSTRUCTED TEST SITES (9-10 YEARS)

pH 7.0 - 7.4

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
7 FC	7.0	58	8	3.5	3	2.5	3	2.5	<2
14 GW	7.1	19	4	4.5	2.5	3	4.5	2	5
25A ES	7.1	34	8	3.5	3	2	2	3	6
22 BA	7.0	<2	<2	<2	<2	<2	<2	<2	<2
6 SM	7.0	4.8	<2	3	<2	<2	<2	<2	<2
10 OO	7.4	11	5.9	<2	4	3	3.1	2.6	3
17 KS	7.0	10	7.5	7	4	5	10	11	4.5
10 GS	7.1	6.8	<2	<2	<2	<2	4.2	<2	3.5
67 OS	7.0	9.5	<2	<2	<2	<2	<2	<2	<2
3 GW	7.1	17.2	5.9	5.9	11	10	6.1	7	10.5

TABLE B-17. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1967-69 CONSTRUCTED TEST SITES (14-17 YEARS)

pH 7.0 - 7.4

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
72 BA	7.3	700	50.5	32	23	19	18.7	17.9	13.8
32 CS	7.2	24	3	19	<2	2.9	<2	<2	<2
36 KR	7.3	38	<2	2	<2	<2	<2	<2	2
10 PR	7.2	17	<2	<2	<2	2	3	<2	<2
34 RA	7.2	7	2	<2	<2	<2	3.5	<2	<2
183 MR	7.0	2.2	<2	<2	<2	<2	<2	12	<2
1 MC	7.0	<2	<2	7.3	<2	<2	<2	<2	<2
36 CS	7.1	69	46	27.5	18	14.5	12	10	11
3 OA	7.4	18.2	3	3.2	<2	<2	<2	<2	<2
7 LS	7.2	7.5	<2	<2	<2	<2	<2	<2	<2

TABLE B-18. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1952-62 CONSTRUCTED TEST SITES (20 YEARS +)

pH 7.0 - 7.4

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
2 HA	7.0	17	8.5	3.5	2	<2	<2	<2	3.2
39 RS	7.2	126	5	3	3.3	4	<2	<2	<2
31 SS	7.0	<2	<2	<2	<2	<2	<2	<2	<2
32 W18	7.1	6	4	<2	<2	<2	<2	<2	<2
247 NY	7.2	7.1	<2	<2	<2	<2	<2	3.8	2.1
13 HH	7.1	22	3.5	3.5	<2	<2	<2	<2	<2
44 CS	7.3	7.5	4	<2	7	<2	<2	4	<2
3 BC	7.4	20	3	7	<2	24	12	<2	<2
3 SS	7.3	6	<2	3	<2	<2	2.1	<2	<2
1 CL	7.0	<2	<2	<2	<2	<2	<2	2.3	5.8

TABLE B-19. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1983 CONSTRUCTED TEST SITES (0-1 YEAR)

pH 8.0 and greater

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
21 EC	9.0	1400	189	42.9	16.4	48.9	4	4	7
237 MR	8.8	360	22	9	4	4	2.5	<2	<2
35 HD	8.8	213	59	10	3	3	<2	<2	<2
7 SL	8.0	179	69.6	104	27.6	36.5	36.5	22.2	11
17 KR	8.8	73.2	57.4	16.5	6.6	3.4	<2	3.4	<2
277 RS	8.7	900	24.5	13.5	5	4.5	3.5	2	2
170 CR	8.8	235	77.5	39.2	18.2	16	12	39	19.5
205 MM	9.1	330	67.5	40	13	10.5	10.5	10	7
20 EC	8.9	481	223	22	10	7	5.7	8.7	4.8
1 BC	8.9	100	57	22	10.5	8	8	7	7.5

TABLE B-20. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1982 CONSTRUCTED TEST SITES (1-2 YEARS)

pH 8.0 and greater

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
116 OC	9.1	24	3.5	<2	<2	<2	<2	<2	<2
37A CD	8.6	45	14.3	5.4	3.7	2	2.9	<2	<2
14A HL	8.5	3800	1000	1100	530	198	33	89.6	27.6
94 EA	8.7	37.6	3	<2	<2	<2	<2	<2	<2
34 E22	8.4	2.8	<2	<2	<2	<2	<2	<2	<2
4 LC	8.8	16	2.4	<2	<2	<2	<2	<2	<2
88 OC	9.1	23.9	9.2	4.2	17.5	10.5	15.1	4.9	3.7
20 GS	8.5	15.5	4.9	8.2	7.2	6	5.5	3.5	<2
3 LC	8.8	57	34	6.6	5.3	3	3.5	<2	<2

TABLE B-21. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1981 CONSTRUCTED TEST SITES (2-3 YEARS)

pH 8.0 and greater

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
10 RS	8.1	35	10.8	4.2	4.2	3.5	2.2	2.6	2.2
8 CL	8.7	6	4.5	<2	<2	<2	<2	<2	<2
W 16	8.4	17.4	2.2	<2	<2	<2	<2	<2	<2
125 BR	8.4	8.5	<2	<2	<2	<2	<2	<2	<2
83 MH	8.8	13	10	<2	11	<2	<2	<2	2.5
178 OS	8.5	<2	<2	<2	<2	<2	<2	<2	<2
17 LP	8.5	3.5	3	<2	<2	<2	<2	<2	<2
510 BH	8.8	50.4	40.1	22.5	10.7	8.9	5.4	3.2	2.9
16C CS	8.6	39.4	2.1	<2	<2	2.1	2.3	2	<2
444 JT	8.8	9	<2	43.5	9.5	<2	30	<2	<2

TABLE B-22. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1980 CONSTRUCTED TEST SITES (3-4 YEARS)

pH 8.0 and greater

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
71 NS	8.7	9.9	15.6	9	7.9	6.4	16	9	3.7
13 TC	8.7	58	11.5	6	15	8	6	11.5	<2
8 MC	8.6	18	9	4	3	4.5	<2	<2	<2
21 LS	8.5	10.5	10	2	<2	<2	<2	<2	240
266 E17	8.0	2.4	2.3	<2	<2	<2	<2	<2	<2
12 MD	8.3	8	<2	<2	<2	<2	<2	<2	<2
4 ML	9.0	23.5	5	<2	<2	<2	<2	<2	<2
WJ PT	8.2	19.5	<2	<2	<2	12	7	8	<2

TABLE B-23. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1979 CONSTRUCTED TEST SITES (4-5 YEARS)

pH 8.0 and greater

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
40 E15	8.4	12	9.6	<2	2	<2	<2	<2	<2
5 HD	8.4	24	4	<2	<2	<2	<2	<2	<2
12 MS	8.7	4.3	<2	<2	<2	<2	<2	<2	<2
32 MD	8.4	14.7	<2	<2	<2	<2	<2	<2	<2
8 SC	8.4	87	<2	<2	4.5	<2	<2	<2	<2
6 KC	8.4	59.5	3.9	14.6	<2	<2	<2	<2	10.5
53 LD	8.8	17.5	2.2	<2	<2	<2	<2	<2	<2
34 HA	8.2	15.8	4.1	10.1	<2	<2	<2	<2	<2
25 WA	8.6	9.4	11	4.5	3	<2	<2	<2	<2
7 KC	8.4	10.8	13.5	3.2	3.1	5.1	4	6.1	7.3

TABLE B-24. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1977 CONSTRUCTED TEST SITES (6-7 YEARS)

pH 8.0 and greater

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
104 DA	8.5	20.5	3.5	2.2	<2	<2	<2	<2	<2
39 WS	8.5	4.5	4	<2	<2	<2	<2	<2	<2
12 SM	8.8	8	<2	<2	<2	<2	<2	<2	<2
6 EA	8.4	5	<2	<2	<2	<2	<2	7.3	<2
13 MS	8.0	2.6	2	<2	<2	<2	<2	<2	<2
10 RA	8.6	9	3	<2	<2	<2	<2	<2	<2
3 MC	8.6	5.2	<2	<2	<2	<2	<2	<2	<2
44 BA	8.1	41.7	<2	<2	<2	<2	<2	<2	<2
45 RS	8.4	14.5	4.5	3.5	3.2	2.2	2	3.2	<2
46 BA	8.4	<2	<2	<2	<2	<2	7.1	<2	<2

TABLE B-25. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1974 CONSTRUCTED TEST SITES (9-10 YEARS)

pH 8.0 and greater

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
7 FC	8.4	18	7.5	23	3	<2	34	10	30.5
14 GW	8.0	22.7	2.2	5	<2	<2	2.1	2	<2
25A ES	8.2	19	<2	2.1	<2	<2	<2	<2	<2
22 BA	8.6	<2	2.5	2.5	<2	2	2.5	<2	<2
6 SM	8.7	5.5	<2	<2	<2	<2	<2	<2	<2
10 OO	8.6	3.3	<2	<2	<2	<2	<2	<2	<2
17 KS	8.5	3.2	<2	<2	<2	<2	<2	<2	<2
10 GS	8.1	3.1	<2	<2	<2	<2	<2	<2	<2
67 OS	8.0	3.5	<2	<2	<2	<2	<2	<2	<2
3 GW	8.0	15.4	3.5	6.7	4	48.6	4.5	5	16.0

TABLE B-26. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1967-69 CONSTRUCTED TEST SITES (14-17 YEARS)

pH 8.0 and greater

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
32 CS	8.4	900	133	56	22	10	7.5	5	8
36 KR	8.7	80	<2	<2	<2	<2	<2	<2	<2
10 PR	8.4	4.3	<2	<2	<2	<2	<2	2.2	<2
34 RA	8.4	2.6	<2	2	2.2	2.1	2.1	2.2	<2
183 MR	8.7	2.5	<2	<2	<2	<2	<2	<2	<2
1 MC	8.8	<2	<2	<2	<2	<2	<2	<2	<2
36 CS	8.6	54	43	13.5	11.5	11	8.5	6	5
3 OA	8.2	9.8	6	<2	<2	<2	<2	<2	<2
7 LS	8.5	8	<2	<2	<2	<2	<2	<2	<2

TABLE B-27. LEAD AT TIME INTERVAL AFTER FIRST DRAW
1952-62 CONSTRUCTED TEST SITES (20 YEARS +)

pH 8.0 and greater

Test Site	pH	Lead (ug/L) at Time Interval after First Draw							
		0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
2 HA	8.3	3.1	<2	<2	<2	<2	<2	<2	<2
39 RS	8.4	82.4	4.7	5	3.1	<2	<2	<2	<2
31 SS	8.6	2.2	<2	<2	<2	<2	<2	<2	<2
32 W18	8.3	4500	<2	<2	<2	<2	<2	<2	<2
247 NY	8.4	4.1	<2	<2	<2	<2	<2	<2	<2
13 HH	8.6	7	<2	<2	<2	<2	<2	<2	<2
44 CS	8.6	3.2	<2	<2	<2	<2	<2	<2	<2
3 BC	8.6	3.5	<2	4	<2	2.2	<2	<2	<2
3 SS	8.4	6	5.8	<2	<2	<2	<2	<2	<2
1 CL	8.0	<2	<2	<2	<2	<2	<2	<2	<2

TABLE B- 28. LEAD AT TIME INTERVAL AFTER FIRST DRAW
PRIVATE WELL SUPPLY - COUNTY OF SUFFOLK

Test Site	Year Constructed	pH	Lead (ug/L) at Time Interval after First Draw						
			0 Secs	10 Secs	20 Secs	30 Secs	45 Secs	60 Secs	90 Secs	120 Secs
MP EM	1983	6.8	54	6.8	3.2	2.5	3.1	3.2	2.4	2.1
SL EM	1983	6.0	11.3	2.1	5.1	23.5	10	7.9	3.2	2.1
AA SY	1983	6.0	9.8	8.6	7.4	8	5.2	4.6	5.1	5.3
KR SO	1982	6.2	41	133	24	13.1	10.3	9.2	9.3	8.9
JC RD	1982	6.2	15	9.1	11.7	9.8	7.2	6.4	6.6	9.7
JS NS	1982	6.6	9.1	5.5	5.6	3	3.9	3.2	2.9	2.1
BR WR	1979	5.6	68.8	12	8	16	8	4.3	3.3	2.5
OS OR	1977	6.5	2.5	<2	<2	<2	<2	<2	<2	<2
NC WR	1977	5.9	5	<2	<2	<2	<2	2.5	2.5	10.9
SC WR	1974	6.6	13	<2	<2	<2	<2	<2	<2	<2
FL WR	1974	6.1	29.7	13	7	5.5	4.9	7.2	122	5.5
LI MD	1974	5.8	9.3	<2	<2	<2	<2	<2	<2	<2
FH CA	1968	6.4	24	12.9	8.6	7.1	8.9	16.8	18.1	18.2
PA RD	1962	5.9	58	6.1	3.1	2.3	<2	<2	<2	<2